SCIENTIFIC AMERICAN SUPPLEMENT. No 1061

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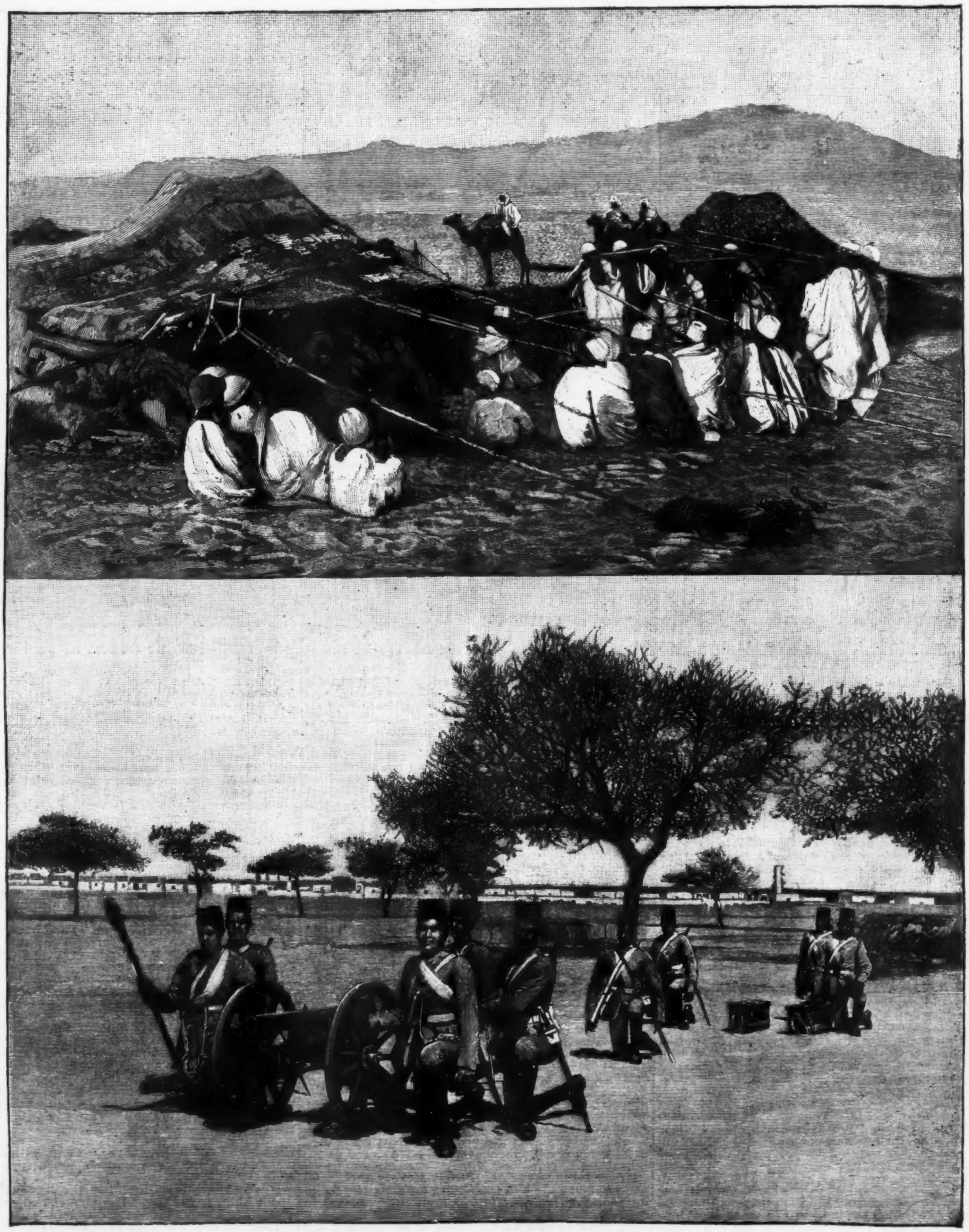
Scientific American Supplement, Vol. XLI. No. 1061.
Scientific American, established 1845.

NEW YORK, MAY 2, 1896.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



1. A Bedouin encampment. 2. A gun of the mule (or camel) battery, ready for action.

THE BRITISH ADVANCE UP THE NILE—TYPICAL SCENES.

THE BRITISH NILE EXPEDITION.

WADY HALFA, the present frontier post of the British government on the Nile, is 200 miles above Assouan, and the territory between the two places is subject to frequent raids of the Dervishes, while the region beyond Wady Halfa is under the rule of the Mahdist Khalifa resident of Omdurman, close to Khartoum. Wady Halfa is about 1,000 miles south of Alexandria, and, together with Khartoum and all of the eastern Soudan, was under the Egyptian government until after the rebellion of Arabi Pasha, in 1881. The crushing of that rebellion by England, and the consequent establishment of a protectorate over Egypt by the British government, for the security primarily of the Suez Canal, while it brought to Egypt proper a better government, and a period of great prosperity, left a very uncertain and troublesome boundary question on the Upper Nile. Beyond Egypt lies Nubia and the Soudan, a vast but ill defined territory, extending from the Red Sea to Kardofan and Darfour. The Italian forces, advancing against Abyssinia from the Red Sea, occupied a portion of this territory, and their possession of Kassala was considered as tending to make more secure the British frontier line in Upper Egypt, but the recent reverses suffered by the Italians have induced special activity among the Dervishes, who have been credited with a determination to force back the English in Egypt as well as the Italians on the Red Sea.

For several months past, preparations had been going forward in Egypt for the making of an advance up the Nile, and this movement, somewhat hastened by the Italian reverses, is now in full progress, although active operations in the region around Dongola are not expected to be begun in earnest until September or October, when the rise of the Nile will permit of moving troops and supplies by water.

Our illustrations on the first page, for which we are indebted to the Illustrated London News, represent a picture in the life of the Bedouins of the desert, and one of the modern Egyptian soldier, as drilled in light artillery practice by English officers. The guns are carried on the backs of mules over stony ground or in rough country, but by camels on sandy stretches. Other pictures representing the use to which the camel is put in this expedition are from Black and White.

The difficulty of moving troops into and through outside Suakim, where my friend, Col. Lewis, told me that out of sixty men in his center company, eleven dropped almost simultaneously, but the forty-nine continued volley firing with the utmost coolness.

"Of the force of 9,000 men available for the invasion of Dongola, it may be roughly said that 5,000 are Egyptians and 4,000 are blacks. The latter are strong in the very qualities in which the fellah is weak, but, unfortunately, the converse is equally true. The black soldier is a man of very limited intelligence, liable to get 'mozthered' if he is ordered about, and capable of keeping his sights up for 1,000 yards in the closest action. He has the primitive man's instinct to break ranks and to clinch. His officers in action have a hard task to keep him in hand. But he is a fine, high blooded, meat eating creature, brave to the verge of ferocity, and consumed with hatred against the men with whom he is about to fight.

"The poor, muscular, brainless fellows, without powers of combination, have always been the favorite prey of the Arab slave hunters, and the negro soldiers fully understand the racial wrong which they are now to have an opportunity of avenging. Physically the negro troops are magnificent fellows, tall and square shouldered, with fine torsos, but a little thin in the legs, which does not prevent them from being excellent marchers. The greater part of them are veterans, for, since the dervish power lies between them and their homes in the mountain country to the north of the equator, they have no choice but to spend their lives in the one trade for which they are fitted."

LAMPEDUSA AND ITS SPONGE FISHERY.

By JOHN H. COOKE, B.Sc., F.G.S.

THE discovery of sponge beds off the African coast that was made a few years ago was the means of giving a great impetus to trade among the islands in the vicinity of the fishing grounds, and caused public attention to be directed to a region that had hitherto been looked upon as being, if not unknown, at least unworthy of any serious consideration.

But it cannot be said that either the climate or the geognostic peculiarities of the islands are answerable for this, for it is demonstrable that while the climate of Lampedusa and Linosa, the two principal islets of the group, is in some respects more favorable than is that of the Maltese Islands' the soil also is very rich and is capable of producing crops equal to any grown in any other region of the southern Mediterranean.

Lampedusa, the largest island of the group, is situated on the edge of a submarine plateau that extends for a distance of about 100 miles from the coast of Tunis, after which it wends to the north and connects Sicily with northern Africa by means of a shoal known as the "Aventure Bank." Viewed from the sea on the eastern side, the island presents an undulating and low lying coast line which is much broken up by numerous small bays and creeks, none of which, however, are sufficiently protected to serve as safe anchorages for weatherbound vessels.

Falling back from the shore in gentle declivities, that are intersected by numerous ravines and valleys, the land gradually rises toward the north till it reaches the height of about 300 feet above the sea level, when it breaks off abruptly and forms along the northern shore a line of precipitous cliffs that descend sheer to the water's edge. The cliffs continue in a westerly direction toward West Cape, a short distance beyond which they break off, and a deep and narrow valley opens out to the sea, on the opposite side of which the strata again rise, and a similar though less precipitous coast line prevails as far as the detached rock which is known as Rabbit Island.

Each of the valleys that abut on the shore has a low, sandy beach at its mouth.

It has been computed that the island contains about 1,200 Maltese salms of land of agricultural value, of which not more than 40 salms were cultivated prior to the survey that was made in the early part of the present century.

Of these it was ascertained that 230 salms might readily be converted into first rate soil, 270 salms were specially adapted to the growth of forage, vines, etc., and the remaining 700 salms would have served as excellent pasture grounds.

At the beginning of the present century the island was uninhabited; and the British authorities were induced to take it over. It was, accordingly, placed in their hands and a small colony of Maltese were sent over, together with a detachment of soldiers, but the greater number of the colonists soon returned, and in 1814 the place was again entirely abandoned.

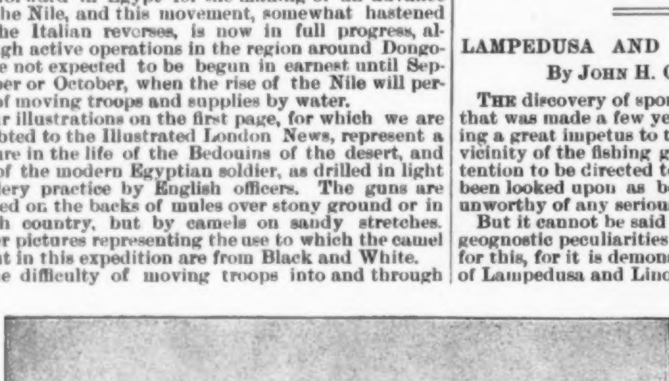
Since then the island's resources have been utilized by the Italians; agriculture has been fostered, and trade has been established with the neighboring continents. The surface of the island now presents a m[ore] fertile and pleasing aspect; for the carob, the vine, th[e] wild olive, and the sumac all flourish luxuriant[ly] in its soil.

It has a scattered population of about 1,000, the ma[jority] of whom gain their livelihood by agricult[ure] and fishing. In the summer season these numbers a[re] considerably augmented by the foreigners who co[me] to fish on the banks for sponges. It is only of la[te] years that this industry has sprung up. In the ye[ar] 1887 an Italian fisherman while trawling in the vicini[ty] of the island discovered evidences of the existence o[f] several extensive sponge beds. Application was [at] once made to the Italian authorities for the necessa[ry] permission to work the beds. This was granted in th[e] following year, and preparations were made for co[m]mencing operations.

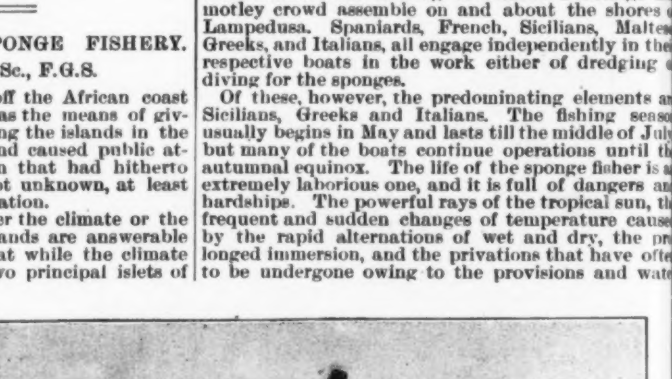
But upon arriving at the banks he found a score o[f] Greek boats, the owners of which had heard of th[e] discovery and had already been hard at work for so[me] months before the Italian's arrival. Since then th[e] banks have annually been a scene of the busiest i[n]dustry during the months of May, June and Jul[y]. Operations were at first confined to the shoals ne[ar] the shore, but were afterward extended to three bank[s] situated at a distance of about thirty miles from th[e] shore, one lying to the northwest, one to the nort[h] and the third to the west of the island.

Of these the last two are the most frequented, a[s] they are not only more extensive than the first, b[ut] the sponges are of a finer quality and are therefo[re] more marketable. During the season a strange an[d] motley crowd assemble on and about the shores o[f] Lampedusa. Spaniards, French, Sicilians, Maltes[e], Greeks, and Italians, all engage independently in the[ir] respective boats in the work either of dredging o[r] diving for the sponges.

Of these, however, the predominating elements a[re] Sicilians, Greeks and Italians. The fishing seaso[n] usually begins in May and lasts till the middle of Jul[y], but many of the boats continue operations until th[e] autumnal equinox. The life of the sponge fisher is a[n] extremely laborious one, and it is full of dangers an[d] hardships. The powerful rays of the tropical sun, th[e] frequent and sudden changes of temperature cause[d] by the rapid alternations of wet and dry, the pro[longed] immersion, and the privations that have ofte[n] to be undergone owing to the provisions and wat[er]



THE BRITISH NILE EXPEDITION—A PARTY OF SCOUTS.



THE BRITISH NILE EXPEDITION—FINEST CAMEL IN THE CORPS.

this desert country is very great, as all supplies for an army must be brought from down the river. For hundreds of miles the arable land on each side of the river does not exceed half a mile, and in some cases is only a few hundred yards wide. It was in anticipation of trouble with the Dervishes and the necessity of being able to move their forces when the water in the Nile was low that the English organized, about two years ago, a camel corps, in which were 2,000 camels.

As to the probable efficiency of the Egyptian soldiers, as they have been drilled by English officers, we copy the following from a sketch written by A. Conan Doyle for the New York Herald:

"If the Egyptian has not developed into a soldier now, then nothing will ever make him one. He has been well used, well clad, well armed, well drilled and sedulously watched over by a series of the best men whom England could supply. Evelyn Wood, Grenfell, Kitchener, Wodehouse, Chermside, Hunter—these are among the men who have had the training of him. Have they really succeeded in stiffening that supple Oriental back? The yes or no will mean a good deal to England. There are some qualities which everyone will allow to the fellaheen troops. They drill remarkably well. So taken were they by the mere idea of drill in the early days of their training that they would fall in and practice in squads of their own free will at the most unreasonable hours. Their maneuvering is as regular as that of good British infantry, but with less snap and swing in it. Their shooting is above the average—undoubtedly better than that of their black comrades. With a spade they are about the most handy men in the world, as Kaffir-dowar and Tel-el-Kebir would testify. Willing, obedient and orderly, they are also endowed with considerable powers of passive endurance if you do not hustle or rush them. If they could only be stiffened up to hold their rifles straight when a swarm of wildcat Dervishes are upon them, then they might yet carry this matter through without British help.

"The new fellah regiments have already been tested, and have stood the ordeal very well, though it was not so severe a one as that to which they will now be exposed. At Ginnes the bulk of the work was done by the blacks and the Highlanders, but the fellahs showed no sign of weakness. Again, when Nejumi came down into Nubia, and when his desperate famine stricken crew were destroyed at Toski, and the battle which preceded Toski, the Egyptians held their own with the rest. The same may be said in the skirmishes

running short are a few of the many hardships th[at] they have to endure.

When a good "field" is struck, the work goes merril[y] forward, and the boats rapidly load and return t[o] port; but when, as it sometimes happens, the boat[s] are delayed in their work, either on account of stress o[f] weather, derangement of apparatus, or some othe[r] analogous cause, the time for which the crew has bee[n] provisioned is exceeded, and reduced rations and su[f]fering are the result.

Occasionally, too, a stiff "gregale" springs up, an[d] as the Lampedusa creek offers no protection to them the boats are scattered toward the African shore an[d] thus driven miles away from the fishing grounds.

The boats used for the work are of a class known a[s] the "trabaccolo."

They are specially adapted for dredging purpose[s], as they can be readily handled, and are capable o[f] sailing so close to the wind that the rate of sailing ca[n] be varied to any speed that may be required for th[e] operations of casting, of towing, and of hauling in th[e] net.

The average size of the boats is about twelve ton[s], and they generally carry five men.

The net that is used for the work is of peculia[r] construction. Among the fishermen it is called "i[n]gagova," a word that has been borrowed from th[e] Greeks, and it consists of a net made of stout hempe[n] cord. It is trapezoidal in form, and it is affixed to a[n] iron frame which serves as the mouth of the net. Th[e] casting of the net requires considerable dexterity o[n] the part of the men, so as to insure its falling on th[e] bottom with the right side down. When in the sea i[t] is towed from the end of a boom by means of a manil[a] rope, and the whole apparatus is so adjusted that th[e] net is maintained in a position directly in the wake o[f] the vessel.

Should, however, the sea be rough, towing opera[tions] have to be suspended, as it is only with a smoot[h] sea and a light, fair wind that the dredge can b[e] worked.

It is upon such occasions that the "palombari," o[r] divers, show to the best advantage the superiority o[f] their system over that of the dredgers.

They can continue their work long after the other[s] are compelled to suspend operations; and not onl[y] can they work more rapidly, but they are also enable[d] to pick the finest specimens from the sea bed, and s[o] the results of their labor always command the highes[t] price in the market. Like the dredgers, they also us[e]

the "trabaccolo" for their work. As a rule, two men do the diving, while the other three attend to the diving apparatus; but not more than one man from each boat is in the water at the same time. They usually remain under water for periods varying from ten to twenty minutes, and they make five and six descents a day. The machine that is used is that known as the "Sdebe Ermanan system." It consists of three cylinders, and is so constructed as to be specially adapted for the work. The average cost of the complete diving outfit is about £100.

The advantages that the divers have over the net fishers is universally admitted, but the initial outlay that is required for the equipment of the former is an insuperable obstacle to its adoption by the majority of the fishermen. As an instance of the amount of work that a diving boat can do in a season, and of the manner in which this special kind of work pays, the following items may be compared.

The boat and the machine of the divers costs about £160, and the working expenses for the season are about £240. This represents an initial outlay of £400. The average "take" for fifteen days' work is 180 oche (225 pounds) of the finest quality sponges, the market value of which is about £144.

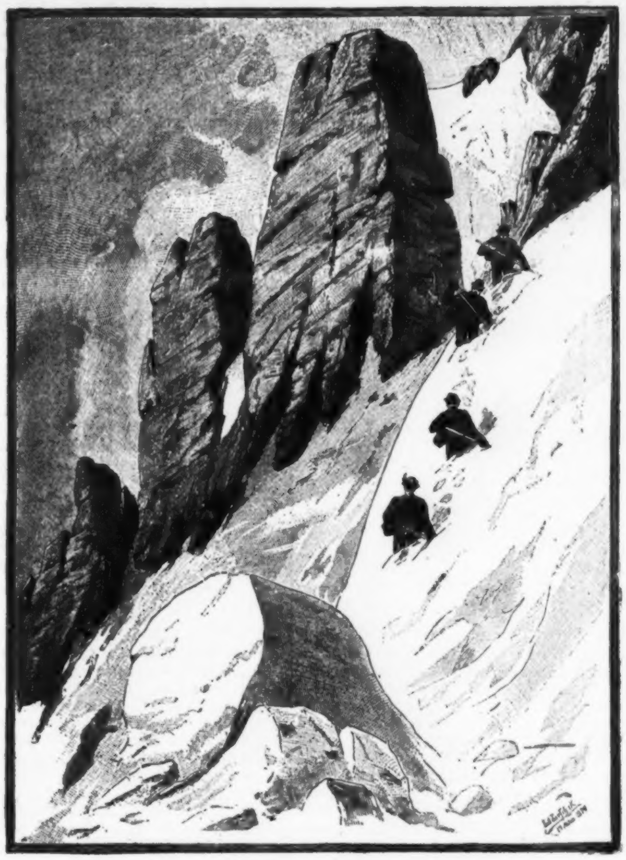
Larger boats and sometimes a steamer attend on the divers and tranship their cargoes, so that they have no occasion to leave the ground until the end of the season.

The profitable nature of the occupation is therefore apparent. There is no doubt but that, judging from the nature of the conditions under which these sponges grow, there are numerous similar beds scattered over the great submarine plateau that occupies nearly the whole of the area of the southern part of the central Mediterranean. Further researches will no doubt bring them to light, and there will then be no reason why, if proper precautions be taken for the protection of the sponge while in an immature state, another regular and thriving industry should not be established in Mediterranean waters.—The Lyceum, Malta.

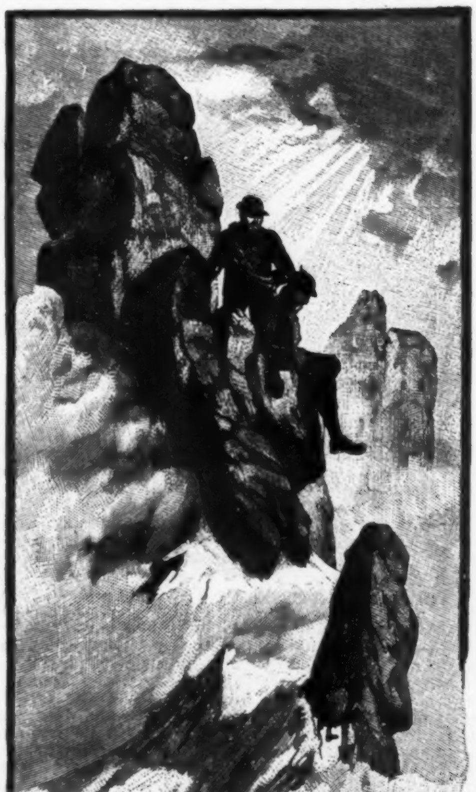
PERILOUS ASCENT OF MOUNT CRISTALLO IN THE DOLOMITES.

WE publish herewith some striking engravings (for which we are indebted to the Illustrirte Zeitung) which give a good idea of some of the difficulties that have to be encountered by those who undertake to climb the Dolomites. A party started one morning at 3:40 from Tre Croci, which has an elevation of 5,946 ft., to ascend Mount Cristallo. After a walk of three hours and a half they reached the Cristallo Pass (8,530 ft.), where they left everything not absolutely necessary and fastened themselves together with ropes, and then they passed out upon a ledge where the deep snow threatened every minute to slide off, carrying the men with it down into the depths below. They climbed through difficult gorges where the Italian guide had to cut steps for them, but as his shoes were provided with spikes he could advance more rapidly than those in his charge, who toiled along slowly in spite of his "avanti, avanti, signori." Finally when they reached the ridge of the mountain they rested and took a bite or two. At 10:30 they reached the snow capped summit (an elevation of 10,495 ft.), but no view rewarded them for their efforts, for everything was enveloped in clouds and they had only momentary glimpses of single peaks and of Cortina below them. At 11 o'clock they started down and had scarcely reached the ledge again when it began to snow; later, however, they passed out of the clouds into the sunshine. After going through the Cristallo Pass, as their destination was Schluderbach, they had to cross the Cristallo Glacier, which became steeper and more difficult at every step, being covered with deep snow, so that they were in constant dread of slides. Finally they reached safer ground and soon met some laborers who told them they had watched their descent over the glacier, and that a quarter of an hour after they had passed over it there had been a terrible snow slide that certainly would have caused their death if they had been on the glacier at the time At 6 o'clock they reached the inn where they were to spend the night, and after they had eaten a hearty supper they found it impossible to resist sleep long enough to even prepare for bed.

Although the difficulties encountered in the ascent were very formidable, Mount Cristallo is not a difficult mountain to climb during the summer months.



ON THE CRISTALLO GLACIER.



RESTING ON THE RIDGE.

ON THE LEDGE.

THE PLANET VENUS.

THE planet Venus, as every observer knows, is a difficult and, at the same time, a tantalizing object for observation, for when she is in that part of her orbit nearest to us, and therefore greatest in size, she presents us with only a small illuminated crescent, from which it is impossible to gather much from her surface markings as a whole. Although at her greatest distance from us she presents her whole disk, yet the latter appears so small that even in this case satisfactory observation is not obtainable. We have to content ourselves, therefore, says Nature, with observations made between these two stages, and when her apparent disk is thus semi-illuminated.

That such an important question as the time of rotation of the planet about her axis is not yet definitely settled, is quite sufficient to indicate that the observer has not everything his own way.

Valuable observations were made by the late M. Trouvelot at Cambridge, United States, and Meudon, extending over the years 1877-1891. The chief points to which reference was made were the two kinds of spots, white and gray, one specially prominent in size having appeared on September 3, 1876; the snow caps at the poles, and the bright specks which appeared at their southern extremities; the varying shape of the terminator, which occurred sometimes in the space of a few hours; and, finally, the period of rotation. Trouvelot found that the whitish and grayish spots were very difficult to observe, even under favorable conditions. The former were situated near the terminator, and produced on it slight deformations, which seemed so to alter it as to suggest that these spots are at a higher level than the other parts. The grayish spots, on the other hand, when situated in about the same positions, also deformed the terminator to a small extent, but in an opposite way to those just mentioned, suggesting that these spots lie at a lower level than the parts near them. Another peculiarity of these two kinds of spots which he remarked was their size. The white ones seemed to assume a round or slightly oval form, and were nearly always small, while the gray spots were generally of an elongated shape and of large dimensions, forming sometimes straight bands. That the spots were not necessarily of long duration was also remarked, and they were analogous in their formation to "taches des couches nuages continues de notre atmosphère précédant les pluies, et qu'un simple jeu de lumière fait naitre ou disparaitre." Their contours were described as very vague, those of the white spots being less brilliant and those of the gray spots less dark.

FIG. 1.—October 12, 1892.

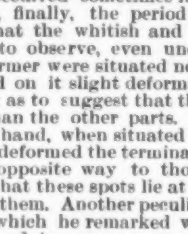


FIG. 2.—September 25, 1893.

In the observations that were made at the Catania Observatory and at Mount Etna (Astr. Nach., Bd. 139, No. 3329), and to which a brief reference is here made, the observer, Sig. A. Mascari, describes in detail the appearances of the spots during the years 1892-1895. He also differentiates between the two kinds of spots. "Le macchie oscure si presentano ordinariamente sotto forma di leggiere velature grigie a contorni mai netti, molto deboli, senza alcun limite deciso, ed è assai raro e fortunato quel momento in cui si può arrivare a distinguere con precisione qualche contorno netto." The second type, "Le macchie chiare si rilevano per un maggiore splendore rispetto a quello del resto del pianeta."

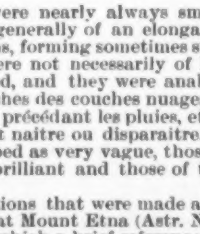


FIG. 3.—October 13, 1893.

From the series of twenty drawings which accompany the observations in the communication referred to above, the surface markings can be clearly followed.

Fig. 1, which is one of a series of four drawings made in the months of October and November, 1892, gives the general appearance of the surface as it was then observed. The three dark patches, A, B, and C, were nearly always visible; a was not always so prominent as is shown in the drawing. The terminator was also at times irregular in shape, being specially so on November 14. The edge of the south polar cap, near the terminator on October 13, assumed a somewhat similar appearance to that which Trouvelot recorded on September 27, 1876. The observations of the latter indicated that the most striking irregularities were found at the extremities of the terminator close to the edge of the pole caps, where deep notches were often recorded. They were of different sizes and shapes, and underwent rapid changes in periods of sometimes a few hours. These facts led Trouvelot to believe in a short period for the rotation of the planet. In the observations for 1893, the terminator was directed toward the east.

Fig. 2 shows the planet for September 25, 1893, from 13h. 50m. to 14h. 52m. The bright spot, H, is bounded on the east and west sides by dark, well-defined contours, e, f, and m. The region about G was somewhat obscure; the area inclosed by i, m, n was bright and sometimes circular, being bounded, for the most part, by dark, indistinct contour lines.

Fig. 3 shows this more clearly. This drawing, made on October 13, seems to be more typical of the appearance of the disk for this year. The six comparatively large whitish spots, H, I, G, N, M, L, are here clearly shown. H is somewhat varied by an incursion of the dark contour line on the east side; I is also sometimes partially bisected by a dark streak, as was the case on November 27, 16h. 50m. (Fig. 4.)

FIG. 4.—November 27, 1893.

The different shapes which the terminator underwent during this year's observation were very prominent, that on November 27 being the most noticeable.

The disk in March, 1895, the terminator being directed toward the east, presented the appearance shown in Fig. 5. One can easily recognize the large white spots, H, I, G, N, M; I appears, however, no longer divided, while L seems to have more or less disappeared, giving place to a prominent circular spot a little more to the eastward. The detail observed during the months of July and August can be best seen by examining Fig. 6, which can be conveniently compared with Fig. 3 or Fig. 4.

With regard to the length of period of rotation of this planet, the difficulties of identifying the spots after brief intervals of time have rendered this point doubtful. Leo Brenner on this point writes (Astr. Nachr., No. 3300, p. 197): Obgleich ich bisher 107 Beobachtungen der Venus zu verzeichnen habe, konnte ich doch erst 22 Zeichnungen anfertigen, weil die wahrgenommenen Flecken gewöhnlich so schwach und unbestimmt sind, dass ein gewissenhafter Beobachter Bedenken tragt, ihre Wiedergabe zu versuchen, weil er fürchten muss, entweder ein Opfer von Selbsttäuschung zu werden oder die Ausdehnung der Flecke nicht richtig aufzufassen. Deshalb halte ich auch die Berechnung der Rotation aus Flecken, die so unbestimmt sind, für ganz und gar unmöglich. Anders verhält es sich aber mit Erscheinungen, welche so deutlich sind, dass sie ins Auge fallen und über deren Wirklichkeit mithin kein Zweifel bestehen kann."

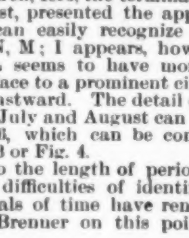


FIG. 5.—March 23, 1895.

It is at present uncertain whether a rotation is performed in, roughly, twenty-four hours, or whether it is accomplished in about 225 days. Trouvelot, from his numerous observations, gave a period amounting to nearly twenty-four hours; while Schiaparelli still adheres to 225 days. Quite lately also Tacchini, from observations made during last summer at the Collegio Romano, favored Schiaparelli's view that the rotation period is equal to the sidereal revolution; and his observations (Atti Reale Acad. Lincei, vol. v. p. 3) toward the end of 1895 have led him to the same conclusion. The observations of Mascari seem, however, to have led him to adopt the longer of the two periods. Cerulli also, from observations made in July, August, and November of last year (Astr. Nach., No. 3319) is inclined to adopt Schiaparelli's length of period. Writing in Astr. Nachr. (No. 3310, p. 368), he says: "Onde si conchiude che la configurazione delle ombre di Venere si mantiene sensibilmente invariabile per molti giorni, e non rivela nessun movimento conciliabile con rotazioni de breve durata."

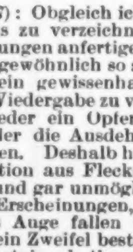


FIG. 6.—July 26 to August 5, 1895.

Leo Brenner, on the other hand (Astr. Nach., No. 3314), is decidedly in favor of the shorter period, and so is therefore of the same opinion as Trouvelot. The former argues that if the spots preserve their positions, then those near the terminator would be for some length of time under the same conditions of illuminations, and therefore would appear the same. This he maintains is not the case, and is not even borne out by the drawings of Schiaparelli and other observers.

It may be remembered that Trouvelot determined his value of 23h. 49m. 28s. from the observations of certain spots, but he also stated that many of the general features visible on the planet's surface, such as the rapid deformations of the horns and of the terminator, etc., all suggested a short period of rotation, and were "inconciliable avec la période de rotation, si lente et si inattendue, déduite par l'eminent astronomie de Milan."

Brenner, who has observed Venus some 275 times, says that the spots move with a velocity of 15''·030 in one hour, thus indicating a period of 23h. 57m. 7·5459s. In fact, he seems so convinced of the accuracy of his observations that he has published a map of the surface of Venus and finds that drawings by numerous observers agree well with it. He maintains, also, that the dark spots are true appendages on the planet's surface and are not connected with the cloudy atmosphere. (See Astr. Nachr., No. 3300, p. 198, in which he refers to a peculiar shaped spot situated near the South Pole, and a communication from Stanley Williams.)

He accounts for the idea of a long period of rotation having been and still being upheld, on the ground that between 320° and 150° longitude there are several spots which are somewhat alike, six of which lie in a north and south direction, and two in higher latitudes in an east and west direction.

For this reason if an observer does not steadily watch the planet from morning till evening every day, but simply makes an occasional observation, he can then easily mistake one spot for another, and imagine that he is observing the same one when he is really observing another, and thus conclude that no apparent motion of the spot is noticeable.

Whether this be so or not is, however, the question; but one does not feel quite at liberty to state definitely that therein lies the cause of Schiaparelli's, Tachini's, etc., deductions of a long period, for certainly they must have convinced themselves thoroughly that such a rapid rotation, which, according to Brenner, is so apparent, was nevertheless to them very difficult of observation before they committed themselves to definite statements.

The following, but somewhat incomplete, list gives some idea of the views held by observers regarding the time of rotation of the planet under discussion. Column I gives the names of those who advocate the short period of about 24 hours; column II, with one exception, those who are inclined to the period of, roughly, 225 days; and column III those who are doubtful. The dates against some of the names refer to the times at which the respective observations were made.

I. Short period.	II. Long period.	III. Doubtful.
D. Cassini (1667)	Bianchini (1727) >24 d	Herschel, Sir W.
J. Cassini (1730 ?)	Schiaparelli	Beer and Madler (1833-36)
Schroter (1788-93)	Cerulli	
De Vico (1840?)	Tacchini	
Trouvelot (1877-91)	Mascari	
Leo Brenner		
Stanley Williams		

During the first few months of this year the planet will be a morning star. From the middle of January to the middle of May, her time of rising before the sun diminishes from three hours to half an hour, her apparent diameter decreasing during this time from 16'' to 10''. After August she will become an evening star, her apparent distance from the sun increasing. In the middle of November she will set one hour and a half, and toward the end of December three hours, after the sun; her apparent diameter at this latter epoch being 15''.—W. J. S. L.

DEPILATORIES.

IN a recent article in the London Lancet the writer says it is idle to ignore the fact that a great deal of unhappiness is often caused by bodily defects which are so slight as to be almost beneath the notice of a physician; yet, if remedies can be found for such trifling ills, it is better that they should be intelligently prescribed by those who have had the requisite training and knowledge. It is the neglect of trivial ailments that is often responsible for quackery, and it is the duty of the medical profession to save people from that resort as much as they can. Therefore, he says he does not hesitate to make a few comments on a subject that is barely mentioned in the textbooks.

The ordinary components of these so-called depilatories he says are quicklime, soda, and a combination of sulphur and arsenic. The powder is made into a paste, spread on the face or other part, and washed off as soon as it is dry. It acts by desiccating and dissolving the hair shaft, and by reason of its irritating nature in unskilled hands, is apt to give rise to troublesome consequences. Erasmus Wilson, he says, narrates the case of a young lady who had been making an experiment of this sort on her forehead for the purpose of getting rid of a tuft which interfered with the mode of wearing the hair then fashionable. She had unfortunately allowed the depilatory to remain on too long, and it resulted in a slough of the size of a shilling, followed by an unsightly scar. The safest of such applications is a paste of barium sulphide and starch, regulated in strength to the delicacy of the skin and applied by skilled hands. Kaposi mentions that in the Orient among the Jews a paste is used for the periodical removal of the stubble of the beard which consists of orpiment and slaked lime boiled with water. In this instance the after growth does not appear until two or three weeks have elapsed, when the application has to be repeated. But all these methods, says the writer, are at best only palliative, for the formative organ remains, and they are all equally apt to be followed by a stronger growth of the hair, and sometimes they give rise to ugly marks and scars. Ointments have been employed, but in general they are to be deprecated, for greasy applications tend to promote the growth of hair, as for instance, on the backs of the hands when vaseline is used to prevent chapping in cold weather. Nevertheless, a strong resorcin ointment, accompanied by powerful friction, has in the practice of a few found favor. The introduction of chromic acid and other caustics into

the hair bulb by means of a needle is uncertain, on account of the difficulty of regulating the resulting inflammation. Another popular method of disposing of extraneous hairs is by the tweezers, a painful process, and, like the preceding and the razor, only temporary.

All these methods, however, the writer goes on to say, are unsatisfactory, and it is to our American cousins that we owe the introduction of the only efficient means for the destruction of hair bulbs. It was an ophthalmologist—Dr. Michel, of St. Louis—who first employed electrolysis with success for epilation in cases of trichiasis, and it was afterward extended to dermatology by Dr. Hardaway. The procedure has now become perfected, and has come to be recognized as the least unsatisfactory one for the eradication of superfluous hairs. A blunt needle connected with the negative pole of a galvanic battery, with a current of from a half to one milliampere or more, is introduced into the hair follicle, if possible without injuring it, and the papilla is destroyed by the decomposition products formed, which are probably caustic alkalies. The hair is then either removed or allowed to drop out, and the operation is followed by a minute red mark, which disappears either without a trace or leaving an extremely fine, shallow depression. Very occasionally these tiny scars subsequently take on a keloid growth. But electrolysis, says the writer, is a tedious process, for no more than twenty or thirty hairs can be removed at a sitting, a circumstance which is open to misinterpretation, if the patient is not warned beforehand of the number of sittings required; and, though these hairs never grow again, others come forward and have to be dealt with from time to time until all are eradicated. But in the hands of a skilled practitioner this method gives a sufficiently satisfactory result in a limited, localized tuft, provided the patient does not mind the inevitable little temporary red spots which appear after each sitting. But if the growth of hair is in any sense diffuse, on a woman's chin, for example, the tiny hairs beside the old ones keep growing up as the others are destroyed month by month and year by year, so that an almost unlimited attendance is necessary. Indeed, so indefinite is the treatment and so frequently do complaints arise on that account, and if the current is not very carefully adjusted, so difficult is it to prevent temporary disfigurement, that many professional men of standing refuse to undertake these cases. This determination on their part the writer believes to be a mistake, as the unsuccored sufferer flies to quackery.

Electrolysis is the only means known up to the present time which in capable hands is able to destroy the papilla whence the hair grows, without risk of producing serious consequences. All the other procedures, including those above mentioned, only result in destruction of the hair shaft, in which case they are not much superior to the razor; or if the cuticle is penetrated, widespread suppuration and resulting scars are apt to be produced. It is therefore the duty of practitioners to warn their patients against them, and especially against trusting themselves to treatment with these powerful remedies at the hands of unqualified, irresponsible, and often wholly unscrupulous persons.

FAULTY ATTITUDES IN CHILDREN.

I TOOK a child (a boy twelve years of age, of good muscular development and exhibiting no vertebral deviation) and photographed him in the attitudes necessitated by the various methods of writing applied in primary schools.

After taking an imprint of the dorsal curve of this boy by means of sheet lead, I drew a line upon his back with India ink in following the spinal apophyses from the seventh cervical to the twelfth dorsal vertebra. Each apophysis was indicated by a mark at right angles with this line and crossing it. I drew two other lines parallel with the vertical column and running along the internal edge of the two scapulas. Each of these lines was intersected at right angles, at its lower part, by another line that fixed the limits, in indicating it, of the angle of the posterior edge of the scapula. In this angle there is a curved line that indicates, in following it, the curve made by the superior edge of the scapula in one of the methods employed.

This line returns to the normal in the physiological attitude that I afterward gave the subject outside of any of the methods extolled.

In the accompanying reproductions of my photographs may be seen the defectiveness of the methods of writing employed. One of them is especially remarkable by the torsional curves impressed upon the spinal column and which are established at every fourth dorsal and lumbar vertebra.

The child is thus obliged to assume a very pronounced cypho-lordose attitude (Fig. 1).

If you ask certain writing masters what attitude should be taken for writing, they will tell you that the whole body should rest upon the left buttock, and that the left side is made for giving a lateral point of support in order to leave the right side absolutely free to work. The photographs taken of subjects pursuing these methods show us that the latter are bad, since the vertebral column is carried from left to right and its deviation is very great, as shown by the reference mark I made upon each photographic print by a plumb line passing through the seventh cervical vertebra and falling four inches outside. The angle of torsion is thus more or less open, according to the method employed. The child is placed in a sloping position upon his seat, the left side within half an inch of the table and the right an inch distant from it. The paper is placed either parallel with the four edges of the table or slightly inclined from right to left (Figs. 1 and 2).

FIG. 1.—Deviation from left to right. Point of support upon the left side. General attitude very faulty.

FIG. 2.—Deviation from left to right. Faulty attitude of the shoulders and head.

In this attitude, the ocular conjugation is poorly established, the accommodation is defective, the muscles of the eye contract, the ciliary muscles become fatigued, and the various muscular tensions in an adopted sense produce affections whose cause the Academy of Medicine and oculists have justly decried. The latter demand a reform through upright writing.

But here we run afoul of habit. The principal argument that has been furnished me by pedagogues is the following:

English slanting writing is prettier, more cursive, and more esteemed by office people and merchants than an upright hand. So that in this matter it is the straightness of the spinal column and the integrity of the vision, and by that fact the beauty and health of our children, that are sacrificed to the form and beauty of a few black marks upon paper. The whole question is, therefore, one of knowing whether we ought to sacrifice a method of writing to the development of childhood or the latter to such method. The answer is not doubtful on the part of physicians, although it appears to be on that of instructors. This is why I have brought the question before the Congress for the Protection of Children; for it is a question of physical protection. An ounce of prevention is worth a pound of cure. I have had the child photographed in an attitude that I believe good (Fig. 3). He has four firm points of support, two upon the olecranons, which are placed flat upon the table and form an angle so much the more open or closed in proportion as the bust is longer. In this, the child instinctively takes the position that is least fatiguing to him. The two other points of support are the two ischions which rest upon the seat. In this attitude the bust is straight, and the vertebral column is not deviated, as is shown by the parallelism of the apophysar line and the plumb line. This attitude having been taken, I place the child very close to the working table in pushing the seat forward so that three-quarters of the thigh may rest upon it, for otherwise the position would be modified by the loss of equilibrium. If the child sits too far back upon the seat, the body will bend forward and the spinal column will form an angle with the axis of the femurs that is more or less sharp, and that will be so much the more pronounced in proportion as the seat is further from the table. In this position the bust curves and cyphosis is produced. The station of the bust being thus well established according to a right angle with the two femurs, I prevent the child from bending forward. If he approaches the table too closely, the edge that presses against his breast will prevent him from breathing, by arresting the costal play in front. He will instinctively lean back, but here he cannot exceed the perpendicular of the right angle formed, thanks to the position taken by the thighs upon the

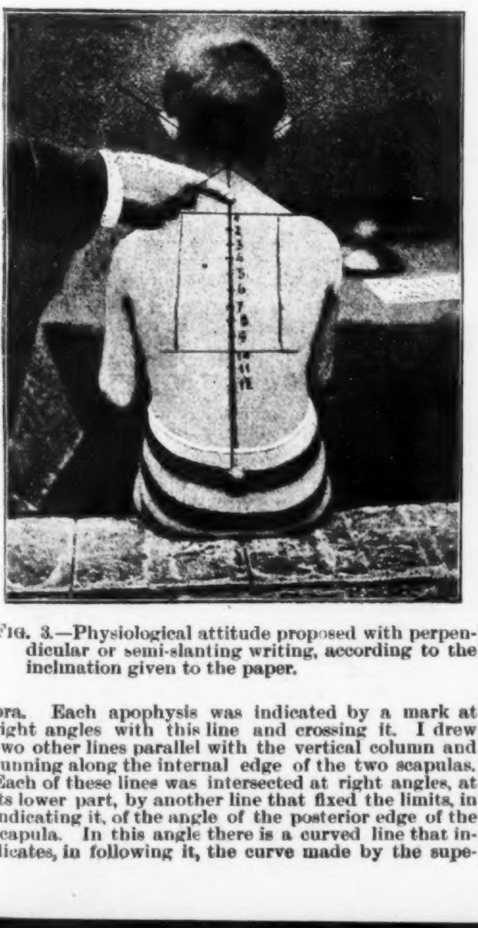


FIG. 3.—Physiological attitude proposed with perpendicular or semi-slanting writing, according to the inclination given to the paper.

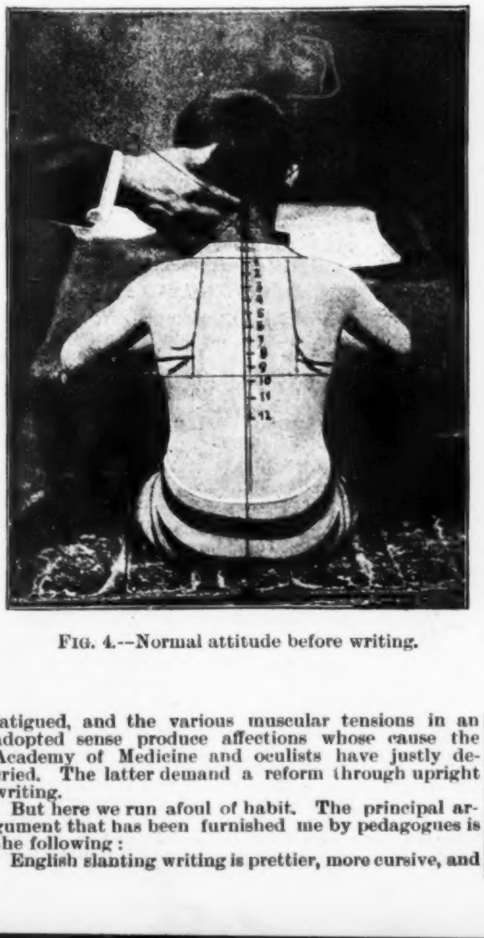


FIG. 4.—Normal attitude before writing.

FIG. 5.—Deviation from left to right. Attitude not so faulty as in Fig. 2.

seat. As for the position of the paper, I believe that the axis of the sheet should be parallel, or nearly so, with the axis of the right hand that holds the pen, the latter being in the axis of the arm. If, in this position, the writing is sloping, let it be so, no matter. If it is straight up and down, so much the better. It is always the case when it is upright and much approaching a round hand that it taxes the ciliary muscles and those of the globe of the eye less to follow the often long flourishes with which our writing is overburdened. On another hand, some writing copies are in blue or brown ink. We think that this practice is bad, since the child is obliged to force his sight in order to perceive the lines of the copy, especially upon a cloudy day or near nightfall. Black ink on white paper seems to us best.

As to etiology, Schenk divides the form and the treatment of faulty attitudes of pupils into two groups, in which he distinguishes the attitudes of fatigue and those of writing. The first, which correspond to the need of resting the fatigued muscles, are very diverse in form, while the second, which are necessitated by the accomplishment of a determinate act, are remarkably uniform. A very efficacious means of remedying the faulty attitudes of fatigue is the adoption of benches with high backs sloping slightly backward. It is much less easy to discover and correct the faulty attitudes due to writing. According to Schenk, the best attitude is that in which the arm is applied slightly against the stomach. In order to render this attitude possible, it would be necessary that the horizontal distance between the back of the bench and the table should be equal to the length of the forearm (from the olecranon to the wrist), and that the vertical distance between the desk and the seat should be equal to that which separates the latter from the pendent elbow of the child.

The methods should be reformed according to the laws of hygiene and infantile physiology. The methods of writing followed in schools ought never to cause a deviation of the spinal column nor ocular fatigue. Sitting upon the two ischions with the two elbows applied entirely to the table seems to be the position indicated.—P. Tissie, in a communication to the Congress for the Protection of Children.—Revue Scientifique.

COPYING.*

By H. C. RAPSON.

A CHEAP and convenient stand I have made consists of a four legged table stand, five feet six inches long, fourteen inches wide and three feet nine inches high, at one end of which is a board fixed by means of two irons attached to the legs of the table by thumbscrews, which allow of the board being taken away when a picture of too large a size has to be copied, when, by means of small wheels on those same two front legs, it is easily moved to a central position opposite a large board fixed to the wall. These boards are marked with a series of horizontal lines and the height of the lens marked, at which diagonal lines mark the center. By means of these lines I fix my picture square, if it is a flat print, but when it is in a book I fix the book as near as possible to guess central; but sometimes that is impossible, as when a small picture is somewhere out of the center of a large sheet, and then it is sometimes handy to be able to shift the camera to one side or the other of the stand, so that, in my opinion, the sliding fixture is, in some cases, a delusion and a snare, as it is perfectly easy to see that the camera is square on the stand. It is also handy to put it out of square when copying photographs which are slightly out of rectilinearity, as the distortion may then be overcome; but if there is much distortion, it is useless to try to rectify it. When your picture is fixed, you slide the camera into position and focus; then, with a heavy camera, no further fixing is requisite; but, of course, you want to be gentle with it in putting in the slide, which should not bite too tight in the rabbets. It will be advisable to always clamp the camera if you are working near a thoroughfare where there is a lot of heavy traffic, as it is surprising what an amount of vibration you can get.

Now, as to fixing the picture to the board, if it is a flat print, all that has to be done is to fix it with drawing pins at the corners, not by sticking the pins through the paper, but at the side, so as to allow the head to hold the edge of the paper. Sometimes it is convenient to just catch the smallest possible edge, and then the pin should be put in slanting, the point away from the picture. In the case of an unmounted print—albumen especially—this is frequently necessary, and also to have a large number of pins, as it is better to do without a cover glass if possible on account of reflections, but if you cannot keep the print flat by those means a cover glass must be resorted to; then put your black focusing cloth round the lens so as to cover all the bright metal and polished wood. This hint also applies to framed and glazed pictures. If the picture has been crumpled it will greatly improve it to iron it, face down, with an ordinary flatiron, and then leave it in a somewhat damp place for an hour or so.

If the picture is in a book, I usually put two strings round as much of the book as is behind the picture and round the board, one at the top and one at the bottom, and draw them as tight as I safely can; then, if the leaves bulge unevenly, I put two thin, narrow strips of tough wood under the strings, which keeps them flat, and then, if the binding holds the lower end more forward than the top, I slip two wedges down, one each side, until the picture is upright. If the book is thin and of very large surface, so as to reach beyond the sides of my board, I have four strong laths which I use instead of the string, and, with one at the back of the board and the other in front of the book, fix the two ends with strong rubber bands; in this case, as a rule, the binding is not in the way.

If the picture is on tracing or other semi-transparent paper, it will give a clearer and brighter negative if a piece of white paper is put at the back.

Now, as to exposure, it is not always advisable to take the well meant tips which you have given gratis on this point, as, if you are copying black and white, you will be told that the shorter the exposure, the stronger the contrast, and, when you say that the negatives still develop soft and flat, you are told to still halve the exposure. Now, my experience is that a black and white negative should develop with pyro and soda in from ten to fifteen minutes, according to temperature, and that if they do not develop in that time, they will be flat through under exposure; and also that if they develop much quicker, they will be flat from over exposure, and it is a very difficult thing to judge by the resultant negatives whether they are under or over exposed. Therefore, always time development, and judge by that. I also find that, with the plates I use, the maximum density, without choking the lines, is obtained in four times the time that it takes to get the whole outline just visible.

Here I should like to mention that there are degrees of black and white. Blacks may range from the pale blue black, with many rotten or half covered places, or the faded rusty black of old books to the intense black of modern engravings, and white range from the faded yellow of some old books and the yellowish cream papers to the pure white of some of the new engravings. It is obvious that the same class of negative cannot be got from a rusty black on faded yellow as can be got from an intense black and white engraving; but it may surprise some that the very white and black print will stand more exposure than either of the others, and the rotten blue black on cream the least of all. But it is from the fact that the intense black will take longer to reflect any appreciable amount of light than the faded ink, while the blue black, being a more actinic color and thin, will stand but very small amount of exposure, though, at the same time, the whites are in inverse ratio; therefore, taking exposure, the ink will stand as two to one, and the reflecting power of the whites as two to one, there will be a difference of four to one in the resultant negatives. That is an extreme case, but such can easily be found. In the case of the faded print, a clean but thin negative can be obtained and is sufficient for some purposes, but for others must be intensified, while a rotten print will never copy well, as every thinness in the ink is exaggerated. So always expose for the longest time that the blacks will stand without developing up, and that is the point where you will get the strongest contrast; with less, the whites take so long to come up that the blacks fog; with more, the blacks will develop before the whites have gained sufficient density, and, as before mentioned, will both be flat.

In copying a black and white photograph two or three times the exposure should usually be given according to the density of the photograph to be copied and the class of negative required. In extreme cases of flatness or a mere ghost of an image, the brightest effect wi l be obtained by exposing the same time as for a black and white, while very hard prints will want four times that exposure. I should always advise correcting errors as much as possible in exposure, as it is easier and more certain, and, in case of more being required, it can be done in development without much loss of time, whereas it, at best, can only be done with great waste of time in development alone. Another reason is that, if you alter gradations in exposure, you can develop two very different negatives in the same dish side by side and get what you want. Do not get your negatives too dense, or your image will show all the marks of the paper copied. I find that a good time for developing photo-copy negatives is three times the time of the first appearance of the whole outline, in all usually six to ten minutes.

There are other methods of copying, as when we want a negative from a negative or lantern slides from the original negative, the only extra apparatus is for the front of the camera, and that may consist of condenser, artificial light and holder for negative or transparency; or for daylight a multum-in-parvo class of apparatus, which is bulky, or a simple stand with grooved runners, which raise or lower at will by means of thumbscrews, which will hold any size from quarter plate to 12 by 10, the intervening space being covered with a black focusing cloth, and as it is inconvenient to work with the apparatus pointing to the sky, a reflector (white paper will do) is placed at the back at an angle to throw the most light into the lens; out of doors that will be 45°, but elsewhere other considerations come in and alter the angle. For making a negative from a negative a transparency must be made; this can be done either by contact or in the camera. From a contact transparency the negative must be made in the camera, and from a camera made transparency the negative may be made by contact, the best method being, perhaps, a contact carbon transparency, as that process gives a softness and range of gradation very difficult to equal by any other process, besides being cheap. It is a process that no amateur need be afraid of, and certainly no professional photographer ought to be without.

* Read before the London and Provincial Photographic Association.

SELECTED FORMULÆ.

Tinted Transparencies.—Every amateur, no matter how successful he may be, now and then spoils a sensitive plate. Though the plate is rendered useless for a negative, it can be made into a pretty transparency with very little trouble. The spoiled plate must first be cleaned from the blackened silver. This is done by placing it in a solution called "Farmer's Reducer," which is prepared as follows:

Potassium ferricyanide	3 gr.
Hyposulphite of soda	30 gr.
Distilled water	4 oz.

Leave the plate in this solution till the silver is all dissolved and the gelatine film which covers the plate is perfectly clear. Rinse it thoroughly in running water, and immerse it for three minutes in a sensitive bath made of—

Bichromate of ammonium	40 gr.
Distilled water	4 oz.

The plate may be cleared from the silver by a white light, but it must be immersed in the sensitive bath by a red light and dried in the dark, as it will discolor if exposed to the light. To make a positive picture on this prepared plate one must have a positive from which to print, and a paper print may be used, if one does not wish to make a positive on glass. Print till the shadows are a deep brown and detail well out, then wash in clear water till all the brown tone has disappeared, and set the plate up to dry. When dry immerse in a color bath composed of ½ oz. of China blue, ¼ oz. of oxalic acid, and 1 pint of water. The plate should be left in the coloring solution till it is a deeper tint than desired when dry, then wash in several changes of water till the water shows no trace of the coloring matter, and dry in a place free from dust. Place a cover glass over the film side of the transparency, and bind first with adhesive strips, which can be bought ready prepared, and then with ribbon, or one may use the frames which are made specially for transparencies.—From Harper's Round Table.

Fluid for Coloring Iron and Steel Black.—For coloring iron and steel a dead black of superior appearance and permanency the right article has long been sought, and, to meet this want, M. Mazure, says Progressive Age, now proposes a fluid, of which the following is the formula: One part bismuth chloride, two parts mercury bichloride, one part copper chloride, six parts hydrochloric acid, five parts alcohol, and fifty parts water, these being of course well mixed. To use this preparation successfully—the article to be blacked or bronzed being first made clean and free from grease—it is applied with a swab or brush, or, better still, the object may be dipped into it; the liquid is allowed to dry on the metal, and the latter is then placed in boiling water, the temperature being maintained for half an hour. If, after this, the color is not as dark as is desired for the purpose, the operation is simply to be repeated, and the result is in the highest degree satisfactory. After obtaining the desired degree of color, the latter is fixed as well as much improved generally by placing for a few minutes in a bath of boiling oil, or by coating the surface with oil and heating the object until the oil is completely driven off. The intense black attained by this easy method is said to be admirable.

To Take Out Milk and Coffee Stains.—These stains are very difficult to remove, especially from light-colored and finely finished goods. From woolen and mixed fabrics they are taken out by moistening them with a mixture of one part glycerine, nine parts water and one-half part aqua ammonia. This mixture is applied to the goods by means of a brush, and allowed to remain for twelve hours (occasionally renewing the moistening). After this time the stained pieces are pressed between cloth and then rubbed with a clean rag. Drying, and if possible a little steaming, is generally sufficient to thoroughly remove the stains. Stains on silk garments, which are dyed with delicate colors, or finely finished, are more difficult to remove. In this case five parts glycerine are mixed with five parts water, and one-quarter part of ammonia added. Before using this mixture it should be tried on some part of the garments where it cannot be noticed, in order to see if the mixture will change color. If such is the case, no ammonia should be added. If, on the contrary, no change takes place, or if, after drying, the original color is restored, the above mixture is applied with a soft brush, allowing it to remain on the stains six or eight hours, and is then rubbed with a clean cloth. The remaining dry substance is then carefully taken off by means of a knife. The injured places are now brushed over with clean water, pressed between cloths, and dried. It the stain is not then removed, a rubbing with dry bread will easily take it off. To restore the finish, a thin solution of gum arabic, or in many cases beer is preferred, is brushed on, then dried and carefully ironed. By careful manipulation these stains will be successfully removed.

To preserve the color of plants J. H. Schroeder gives the results of his experience in the use of oxalic acid for preserving the colors of dried plants. Nienhaus had previously suggested that the fading of plant colors is due to the presence of ammonia in the air, and he therefore recommended that plants be dried between folds of filter paper impregnated with a one per cent. solution of oxalic acid. Schroeder finds that not only are the colors of petals well preserved by this method, but that the use of drying paper prepared with a stronger solution of the acid will preserve the color of leaves. Leaves of a thin texture are well preserved with a two per cent. solution, but thicker specimens are best preserved with a three per cent. solution. The leaves of aquatic plants also require two or three per cent. The general method recommended is to thoroughly saturate heavy gray felt paper with a three per cent. solution of oxalic acid and then dry it. The plants are placed directly between the sheets of prepared paper, only very delicate petals being protected by pieces of thin paper. Change the drying paper once in twenty-four or thirty-six hours, until the plants are thoroughly dry, then mount in the ordinary way. If possible, place the plants in the press at the time of collection, or carry them in an airtight box and moisten before pressing.—Am. Jour. Pharm., lxviii, 132.

To Detect Alum in Bread.—Since the introduction of snow white roller flour, alum is little used; it may, however, be detected in bread by laying a piece about two inches square upon a saucer and then pouring upon it a small portion of tincture of logwood, which has previously been mixed with its own bulk of carbonate of ammonia solution. If alum be present, the bread will turn blue by this treatment, whereas if it be free from any admixture of this kind, it will become pink. Other substances besides alum which might be present in bread have the effect of producing a blue color with logwood, so that all that can be said of the result of this test is that if a blue color is produced, the bread is not pure and that the impurity most probably is alum.—Australian Miller.

An Effective Depilatory.—

Barium sulphide	1 part.
Lime (freshly burnt and slaked)	1 "
Rice starch	2 "
Salicylic acid	q. s.
Glycerine	q. s.
Eau de cologne, or S. V. R.	q. s.

Mix the first three ingredients intimately, then make into a thinnish paste with the spirit, in which has previously been dissolved about 1 per cent. of salicylic acid and 3 per cent. of glycerine. Apply to the part where required, and allow it to remain until a slight soreness is felt; then remove. Repeat application daily until the hairs are removed.—Popular Science News.

ENGINEERING NOTES.

Alexandria's harbor has now a channel 300 ft. wide and 30 ft. deep. The pilotage dues have been abolished and a tax on tonnage has been imposed.

Japan, which is having two big line-of-battle ships built in England, has just placed contracts there for two more. They will be of 14,000 tons each, of the Rinowa class.

It is significant that the recent award of contracts for Russian armor to the Carnegie and the Bethlehem companies was made after a thorough inquiry into the comparative merits of European and American armor.

The adoption of a universal standard thread for screws and bolts is one of the possibilities of the near future. An international conference is about to be held in Europe, having for its object the adoption of a uniform system. This will be in line with the proposed adoption of the metric system of weights and measures.

The bridges of the new Chinese railway are to be designed by Sir Benjamin Baker, the designer of the Forth Bridge. The line to be immediately built will run from Tientsin along the bank of the Imperial Canal, thence northward by the Imperial Summer Palace, ending at the Loukou Bridge. The length is seventy miles and it is to cost $2,000,000.

The American Shipbuilder describes a powerful vessel known as the Danzenbaker ice boat. The hull is 200 ft. long, by 40 ft. beam, with a draught of 9 ft. Heavy sponsons on each side provide increased displacement when the bow is depressed by the weight of the ice. The horse power is 4,000. Instead of riding up on the ice and trying to break it down by sheer weight of the hull, it has a long oblique ram bow, which runs under the ice, cutting it by its sharp edge, and throwing it aside as a plow turns up the sod.

It is said that the deepest lock in the world forms part of the extensive works which are now nearly completed by Barry Docks, situated at the west side of the Bristol Channel. These great works have converted an almost barren island into a great shipping port. The works comprise a tidal basin of seven acres, a dock of seventy-three acres, at the top of the slopes, and a timber pond of four acres. Between the graving dock, which belongs to a private company, and the entrance basin has been built the new deep lock.

A five inch armor plate, representing 350 tons of armor manufactured by the Carnegie company for Russia was fired at on the Naval Proving Grounds. It was attacked by 5 inch and 4 inch shells. The showing made by the plate was highly satisfactory. Under the contract with the Russian government, only four shots are necessary in testing the plates. Two additional shots at the request of the representatives of the Carnegie company were fired, however. The penetration of no shot was greater than two inches. The projectiles were broken into fragments.

Acetylene is being tried as an illuminant on the Paris tramcars, says Engineering. The generator, containing calcium carbide and water, is placed on the rear platform underneath the steps. Though its weight when charged is only 27 lb., it is capable of producing 35 cubic feet of the gas, the illuminating power of which is estimated at 15 times that of ordinary coal gas. The lighting is said to be very efficient, it being possible to read a paper in any part of the car. The cost, so far as the experiments have yet gone, works out at less than that of lighting by petroleum, but as the car has only been in use some six weeks, it is not yet possible to give definite figures.

An ocean tank barge is to be tested by the Standard Oil Company in a trip across the Atlantic. Similar barges have been towed between Atlantic ports for several years, but the company now proposes to tow its barge to Liverpool or some other English port. The barge which is to be used in the initial trip is 250 ft. long by 40 ft. deep and draws 16½ ft. of water. The oil is carried in twelve separate tanks, which hold in the aggregate about 1,250 barrels, or 750,000 gallons. It is probable that the tank steamship Lackawanna will do the towing and will also carry a large quantity of oil in her own tanks. The barge is fitted with steam towing machinery, steam steering gear, windlass and hoister. Tank vessels have been from time to time towed from New York to the West Indies, and a few years ago a floating dry dock was towed from England to Bermuda.

The experience of the New York Central road with extended piston rods for locomotives has been so favorable, says the American Engineer and Car Builder, as to make reasonable the belief that the saving in wear of cylinders and pistons more than compensates for the expense and maintenance of the additional parts. The extended rods have been fitted to quite a number of the heavy 19 inch passenger engines hauling the Empire State and other fast trains, and as these engines come into the shops for general repairs their cylinders have been examined and in a number of cases it was not found necessary to do any work on them, they being sent out untouched for another two years of hard running. Engine No. 870, well known for its regular work on the Empire State Express, made 167,176 miles while out of the shop, and the wear of the cylinders was less than $\frac{1}{32}$ of an inch.

The powerful hydraulic dredge designed by Mr. Lindon W. Bates has recently been put to an official test. The Engineering Record states that on this occasion the machine excavated 7,798 cubic yards in one hour. The conditions were, of course, favorable, but the immense possibilities of the machine may perhaps be realized when it is remembered that 7,800 cubic yards of excavation is equivalent to digging a trench 3 feet deep and 50 feet wide 1,400 feet long, or the excavation of the full width of many streets to a depth of 3 feet for more than a quarter of a mile in one hour. On the Chicago Drainage Canal, where the most powerful steam shovels were built for the special duty, and were served by improved efficient conveying apparatus, the maximum output reported was about 170 cubic yards per hour, an amount greatly in excess of their average duty in the refractory material.

ELECTRICAL NOTES.

At Jouage, above Lyons, the Rhone is to be dammed so as to obtain the water power needed to provide Lyons with electricity.

A new paper has been started in England entitled Aluminum and Electrolysis. It is devoted to the production and use of aluminum.

So successful has the telephone service been between London and Paris that a second cable is to be laid across the Channel, when direct communication will probably be established between Paris and Liverpool and Manchester as well.

A French physician states that if an electric current be passed through a tub of water in which a tadpole is swimming, the animal will immediately turn, so that its head is toward the anode; thus, the current passes in at its mouth and out at its tail.

Russia is to have an electrical branch of her army under a lieutenant-general, two major-generals, and five officers of lower grade, who will also have a military electrical school under their charge. Russian military officers have always been adepts in the use of electricity.

A French inventor has devised a curious electrical alarm for infants. It consists of a microphonic circuit breaker placed near the head of the child in its cradle and connected with an electric bell through the medium of a relay. A cry from the child will actuate the microphonic circuit breaker and will thus cause the bell to ring, awakening the mother or nurse.

In Philadelphia the old cable system has been entirely replaced by trolley cars, and the cable conduit has been taken up and the street filled in. The trolley cars run from the very heart of the city to the most remote suburbs, and all the streets on which the electric cars run are paved with asphalt from curb to curb, excepting between the rails. This paving has been done by the street car companies.

Electricity is now used to detect paste diamonds from the genuine, says the Industrial World. A small disk of aluminum is attached to the spindle of a small motor. A clamp with a small flat spring, provided with an adjustable screw, holds the article to be tested. It is then moistened and placed in contact with the rapidly revolving disk. If the stone is a genuine one, it will be left intact; if it is bogus, it will show brilliant metallic marks.

One of the interesting features of the coming electrical exposition in New York City will be the historical and loan exhibit on the main floor. A choice library of electrical books will also be shown, and the son of the late S. F. B. Morse will exhibit the invaluable collection of telegraphic relics, documents, etc., relating to his father's experiments in telegraphy. Other objects of interest will be exhibited by the Patent Office, by Mr. Tesla, Mr. Edison and others.

An insulator to prevent the humming noise caused by the vibrations of electric wires when they are fastened to poles or other supports has been devised and patented by Magin Riera, of Havana, Cuba. The surfaces of the clamping members, which are in contact, are concave and convex respectively, or have a wedge shaped projection and a corresponding recess, and they inclose between them an elastic filling slotted to about its center to receive the wire, the clamping pieces causing the split portion of the filling piece to closely hug the wire.

In a recent issue of the Elektrotechnischer Anzeiger a description is given of a short railway line on which Schaefer-Heimemann accumulators are used. Each car is capable of carrying 30 persons, and is equipped with 3½ tons of accumulators and a series wound 18 horse power motor weighing 3,000 pounds. The working potential is 250 volts. The batteries are not removed from the car, but are charged during the night when the car is idle; the charging is done in five to six hours. Starting the car on a 1½ per cent. grade requires 8¾ kilowatts, and on the level 6¾ kilowatts. The power consumed at full speed is 4¾ kilowatts. The complete car weighs 9·7 tons.

One of the directions in which inventors seem to be meeting with success is that of a telephone system in which one circuit is made to serve several subscribers. Four telephones can be operated perfectly on one circuit, and it is announced that a system which is being tried with five instruments on a single circuit is operating satisfactorily. By means of party lines, serving several subscribers each, the number of subscribers served by an exchange can be greatly increased at small expense. A large number of residences and business places use a telephone but a few times daily, and yet if placed on separate lines the expense equals that of lines used continuously. The chance of two residences wanting to use the line at the same time has been found to be very slight. Such a system seems to fill every requirement for a large class of telephone subscribers, and the rates should be much smaller than those for separate lines.—Electrical Industries.

A voltaic cell with a carbon anode invented by Dr. Coehn is thus described by the Electrical Review: The starting point in Dr. Coehn's investigation was a fact well known to electro-chemists, viz., that when carbon is used as an anode in electrolytic processes, a solution which gives a brown color to the electrolyte is often produced. By an elaborate series of experiments, Dr. Coehn has determined the conditions under which the carbon anode was oxidized so as to produce carbonic acid and carbonic oxide only. It was found that a certain temperature and a certain current density were necessary to produce this result. The electrolyte is dilute sulphuric acid, and this must also be of the proper density. He next succeeded in precipitating upon the cathode the carbon dissolved from the anode. To supply oxygen at the cathode to consume the carbon, an anode of peroxide of lead was used. The element gives an electromotive force of 1·3 volts. This is a much higher voltage than has hitherto been obtained in batteries, such as Borchers', in which the energy is derived from the combustion of carbon. The greatest practical objection to this element appears to be the use of so expensive a material as peroxide of lead as an anode.

MISCELLANEOUS NOTES.

A bill has been introduced authorizing the New York and Brooklyn Bridge trustees to lease the railway now operated on the bridge, so as to provide for continuous rapid transit, without change of cars, between the cities of New York and Brooklyn by elevated railroads and to reduce bridge railroad fares.

According to the statistics of milling in the last United States census, there were 18,470 mills, with a capital of $208,473,500, which gave employment to 63,481 workmen and paid out annually for wages $27,035,742. The raw material cost $434,152,290 and the product for the census year of 1890 amounted to $573,971,474.

Tristan d'Acunha, the most solitary spot on the earth, has just been visited by the Governor of St. Helena, which lies 1,500 miles to the north of it. He found sixty-one persons on the island, eighteen men, twenty-three women, and twenty children. They have 600 cattle, 500 sheep, a few pigs and donkeys, some hens, and a great many geese. The inhabitants are all total abstainers.

The following is a German device for getting rid of smoke from boilers. By means of a fan the waste gases are drawn off and forced into a gasometer, where they are freed from all solids by bubbling through water, the gases collecting in the upper part of the gasometer. By varying the load upon the bell of the gasometer, the force of the draught may be varied as desired.

A portable crematory for military purposes has been invented by a Polish engineer. It has the appearance of the army baking oven, but is much higher and heavier, and is drawn by eight horses. It is intended for the disposal of the bodies of soldiers killed in battle, so as to avoid the danger of epidemics from the burial of great numbers of men. Each German army corps, it is said, will be equipped with one.

According to advices from Penn Yan, N.Y., a farmer of Italy Hill is disposing of his potato crop in a novel way. He begins by having a good bed of coals in the firebox of his coal stove, and then fills the feeder with potatoes, which, as they descend into the firebox, become kiln dried, and it is claimed throw out an excellent heat. Potatoes are worth about $2 per ton and coal $5. At Canandaigua potatoes are so cheap that farmers are throwing them away. One man is burning them in his stove, and says they make a very hot and steady fire. At some auctions of farm property held lately tubers sold at 2½ cents a bushel, and in many instances no bids could be secured.

The report of the British consul at St. Petersburg states that more than 100,000 estates, or 41 per cent. of the whole area of land held by nobles, are mortgaged to government and private land credit institutions. The amount of money advanced in ten years was $632,500,000, of which only $46,500,000 has been repaid. Of the capital of $250,000,000 of the Government Land Bank, created for the express purpose of helping the landords, but little has been paid back and little improvement has been made in the estates, the money borrowed having been usually wasted. Many of the estates would have been long ago sold under foreclosure of the mortgages if the government had not intervened.

It is stated by the New York Sun that the Cuban delegation in the United States intends soon to publish a book entitled "Cuba. Physical Features of Cuba; Her Past, Present and Possible Future." The author is Señor Fidel G. Pierra, of the Press Bureau of the Junta, in this city. A large edition will be printed and distributed gratis, as the intention of the Junta is to diffuse in this country a complete knowledge of the Cuban question. The Cuban army, as is stated in the book, is organized as follows: First Army Corps, about 5,000 men, commanded by Maceo; the Second, Third and Fourth Army Corps of about 3,000 men each; the Fifth Army Corps of 14,000 men (called the invading army), commanded by Major-General Gomez. Altogether, including smaller contingents, there are claimed to be 45,000 men in the Cuban army.

In relation to Senator Smith's resolution proposing to establish an armor plant at the Washington Gun Foundry, Secretary Herbert has written to the Senate Committee on Naval Affairs stating the following objections: 1. It would be necessary to haul from long distances, and at considerable expense, the requisite coal, iron ore or crude iron and other materials. 2. An establishment large enough to handle the heaviest class of plates would have an output of a much larger quantity of armor than the government would be likely to need. 3. Workers in steel of sufficient skill and knowledge to be employed in the manufacture of armor plates receive very high wages, and it would not be practicable to hire such men when armor is to be manufactured and discharge them when their services are no longer needed. 4. To keep the plant in order merely would require the constant maintenance in the pay of the government of a considerable force of skilled mechanics.

Mr. Rouart has communicated to the Society for the Encouragement of Enterprises, says the Railway Gazette, a project for the transportation of mail matter of every description between the post office building and the railroad depots in Paris. It is contemplated to replace wagons by a system of pneumatic tubes of an average length of about one mile. It is estimated that 1,000 pieces have to be sent through each every five minutes. Tubes of 15¾ in. diameter are assumed, in which boxes weighing 300 lb. and carrying 220 lb. each are propelled by compressed air. Rouart figures that a train of ten boxes, carrying 2,200 lb. of mail and express matter (on the Continent the post offices also handle express matter), would offer a resistance corresponding to a 17¼ ft. water column, of which 10⅝ ft. are chargeable to train friction, and the balance to friction of air in the tubes. A 200 h. p. engine would therefore be sufficient to serve the entire tube system of about six miles total length. The first cost is estimated at $170,000, the operating expenses at $10,000 a year, which is about 10 per cent. of the cost of the present service.

RIGS OF SAILING VESSELS.

WHILE there are not quite so many different rigs of sailing vessels as there are vessels, there are a great many, some of them differing but slightly from others, and there is much confusion of nomenclature, even among those who should know better than to get the rigs mixed in their minds. To aid in dispelling misunderstandings as to the names of the rigs of vessels, or as to how certain named rigs are to be understood, the accompanying illustrations have been prepared, showing a wide range from the smallest and the most simple sailing vessels to the largest and most complicated.

In the first place we may make a distinction by reason of the number of masts, which ranges from one to five. The second distinction may be in the manner in which the sails are attached, extended, and maneuvered; some being on horizontal yards swinging crosswise of the mast, some on yards which lie obliquely to the horizontal, others having booms or gaffs attached at only one end to the mast, and others again having no sprit or spar by which to aid in their extension. Some sails are triangular, others have four well defined sides. Some vessels have all the sails centered at the masts, or are square rigged; in others all the sails are "fore and aft;" and others again have the sails on one or more masts of different type from those on the other or others; while in some, part of the sails on a mast are of one type and the rest of one or more others.

Referring to the illustrations, and considering only the number of masts: A to I inclusive have but one; J to X inclusive, two; and the rest have three. There are vessels having four and even five masts, but these do not require illustration as the sails on the other mast or masts are of the same general type as those on the three.

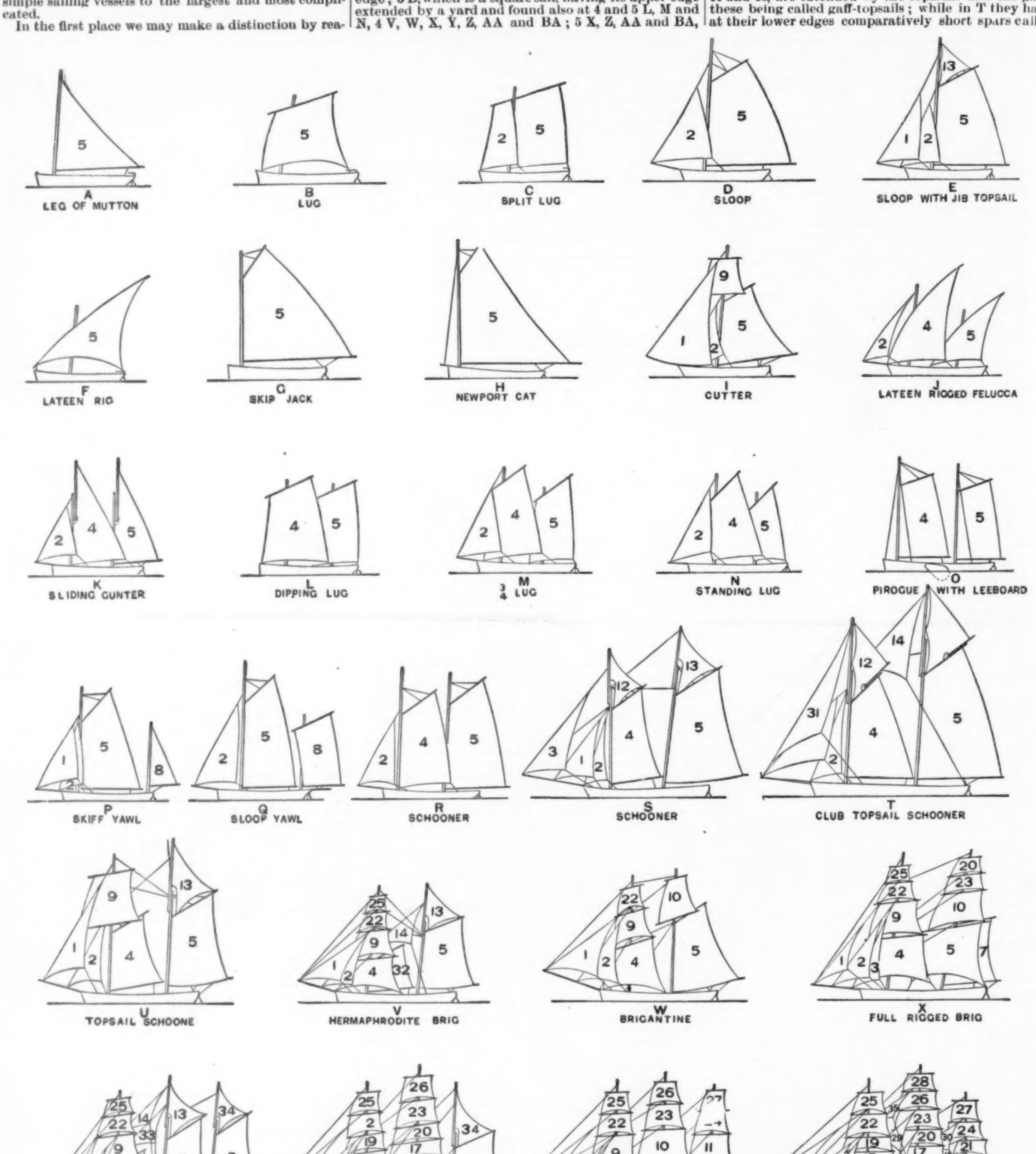
Of sails we have as distinct types No. 5 A, which is a leg of mutton, having a boom to extend its lower edge; 5 B, which is a square sail, having its upper edge extended by a yard and found also at 4 and 5 L, M and N, 4 V, W, X, Y, Z, AA and BA; 5 X, Z, AA and BA, and 6 AA and BA. All these square sails have no yard to extend them on their lower edges.

In vessels F and J there will be seen to be one long yard at an angle to the mast and having its lower end made fast to a convenient point below. This is called a lateen rig.

In vessels D, E, G, H, I, O, P, Q, R, S, T, U, V, W, Y, all sails marked 5 are bent to the mast at their inner edge, and extended by a boom below and a gaff above. These are fore and aft sails. Other fore and aft sails, bent to stays and not to any mast, boom or yard, are the stay sails seen in vessels D, E, I, J, K, M, N, and on all the others from P on, inclusive. The particular sail on vessel A is a leg of mutton sail; on B, a lug sail or lug; on C, a split lug, differing from that on B by one portion being bent to the mast as well as to the yard above. In vessel K may be seen a "sliding gunter," the upper portion of which is extended by a spar which is hoisted alongside of the mast, constituting, practically, a sliding topmast; the sail being bent to both halves of the mast proper. On vessel L there is a dipping lug, and on M a three-quarter lug.

In S we see a schooner the topsails of which, marked 12 and 13, are extended by the topmast and the gaff; these being called gaff-topsails; while in T they have at their lower edges comparatively short spars called clubs, by which they may be more flatly strained than where the attachment is made directly to the corner (or clew) of the sail. In BB we see the topsails double; that is, instead of there being only one sail to the topmast, as in AD, 9, 10, 11, they are double, the upper half being bent to the regular yard above, and the other to a yard which is hoisted on the mast; the object being to enable the sail area to be more readily reduced than by reefing one large sail.

Taking the different rigs in order as lettered, A is a leg of mutton, B a lug, C a split lug, D a sloop (having a single mast and only fore and aft sails), E a sloop



VARIOUS RIGS OF SAILING VESSELS.

having a gaff topsail, F a lateen rig, G a skipjack (having no bowsprit and no staysail nor topsail), H a catboat (which differs from the skipjack only in the hull), I the cutter as known in the United States Navy (distinguished by being sloop rigged, with a square topsail instead of a gaff topsail or a club topsail), J a lateen rigged felucca, K a sliding gunter (having practically a sliding topmast to which as well as to the mast the sail is bent), L a dipping lug, M a three-quarter lug, N a standing lug (one lower corner of the sail being secured to the mast, and the lower edge being extended without a boom), O a pirogue (having no bowsprit, no staysails, and no topsails, and being fitted with a lee board as shown), P a sloop yawl (having a small mast stepped astern and bearing a leg of mutton sail), Q a sloop yawl with a jigger.

R is a schooner having two masts, both fore and aft rigged; this one having no topsails and only one staysail; S a schooner with gaff topsails (sometimes called a gaff topsail schooner), T a schooner with club topsails (sometimes called a club topsail schooner), U a topsail schooner (having a square topsail on the foremast and a gaff topsail on the mainmast), V a hermaphrodite or modified brig (two masted and having the foremast square rigged and the mainmast fore and aft rigged), W a brigantine (having two masts, the foremast being square rigged and the mainmast having square topsail and but a mainsail extended by gaff and boom), X a brig (a two masted vessel square rigged on both masts), Y a barkentine (having three masts, the foremast being square rigged and the other two fore and aft rigged), Z a bark (having three masts, the foremast and mainmast being square rigged and the mizzenmast fore and aft rigged), AA a full rigged ship (having three masts, all square rigged), and BA a full rigged merchant ship (having double topsails as before explained).

The sails as illustrated on all the vessels shown bear the same numbers for the same name throughout. In all, 1 is the flying jib, 2 the jib, 3 the foretopmast staysail, 4 the foresail, 5 the mainsail, 6 the cross jack sail, 7 the spanker, 8 the jigger, 9 the fore topsail, 10 the main topsail, 11 the mizzen topsail, 12 the fore gaff topsail, 13 the main gaff topsail, 14 the main topmast staysail, 15 the mizzen topmast staysail, 16 the lower fore topsail, 17 the lower main topsail, 18 the lower mizzen topsail, 19 the upper fore topsail, 20 the upper main topsail, 21 the upper mizzen topsail, 22 the fore topgallant sail, 23 the main topgallant sail, 24 the mizzen topgallant sail, 25 the fore royal, 26 the main royal, 27 the mizzen royal, 28 the main skysail, 29 the main topgallant staysail, 30 the mizzen topgallant staysail, 31 the jib topsail, 32 the fore trysail, 33 the staysail, 34 the gaff topsail, 35 the main royal staysail.

There are other kinds of sails not shown, as for instance studding sails, which are extended by yards on square rigged vessels; and other staysails than those shown may be set when the wind is light and they can be used to advantage to catch any wind which would not otherwise act on the other sails.

There are other rigs which embody the features of those already shown, such for example as the three masted, four masted, and five masted schooners, the four masted and five masted ships and the four masted shipentine, all of which are an extension of the rigs shown.

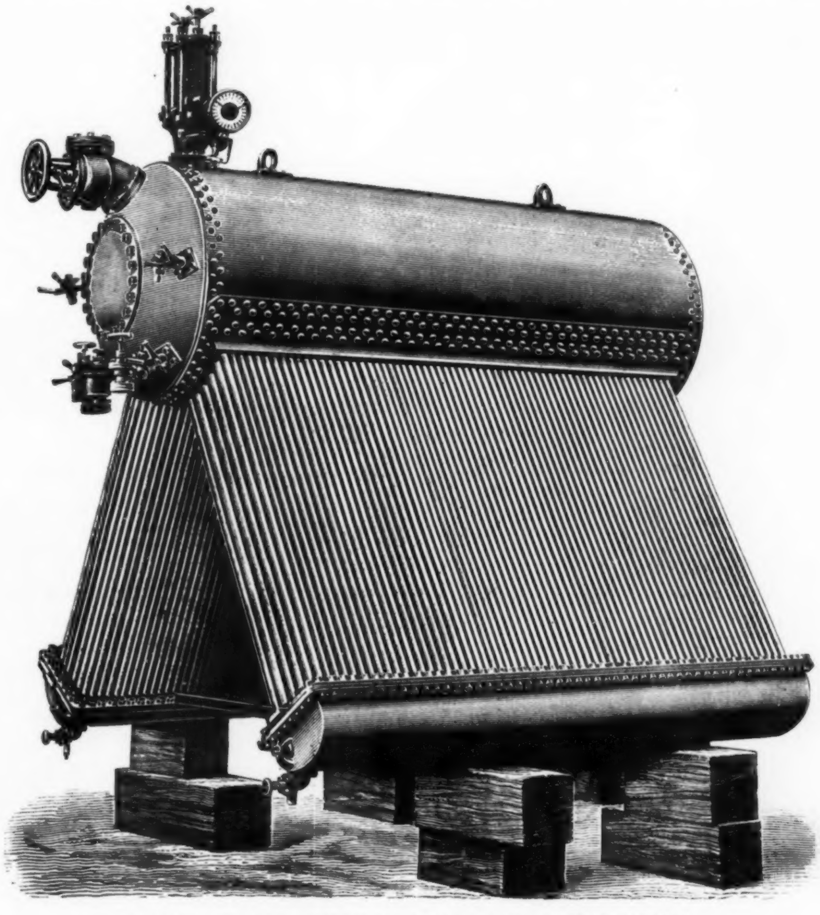
WATER TUBE BOILERS FOR THE DUTCH NAVY.

THERE were tested recently at the works of Messrs. Yarrow & Company, at Poplar, three water tube boilers, which possess features of especial interest. The boilers themselves are of the now well known Yarrow type, having straight tubes and no outside downcomers. On the present page we give an exterior view of one, taken from a photograph. The tubes are of steel, and are 5 ft. long between drums and 1¼ in. in diameter. They are arranged in ten rows on each side of the furnace. The total grate area of each boiler is 40½ square ft. and the total heating surface 2017 square ft.

These boilers are intended for the three cruisers now being built in Holland to which reference was made in our issue of July 12, 1895. They are each to be supplied with both Yarrow water tube boilers and with ordinary return tube boilers. The total horse power is to be 9250, or 250 horse power more than originally intended, and steam for 2250 horse power is to be supplied by the shell boilers, while the remaining 7000 horse power will be obtained by means of the water tube boilers. The intention is to use the return tube boilers for ordinary cruising work, but when a higher speed is needed the water tube boilers will be brought into play, and will work in conjunction with the other boilers. Another main object of the arrangement is to accustom the stokers of the navy to the working of the new type of boiler, while, at the same time, the ship is not entirely dependent for steam on a class of generator of which the manipulation is somewhat strange.

The cruisers referred to are the Zeeland, Holland, and Friesland. Two are being constructed at private yards, one at Flushing and the other at Rotterdam, while the third is being built at a government establishment at Amsterdam. In each ship there will be eight Yarrow boilers and two return tube boilers, so there will be 24 water tube boilers in all. Only the three referred to, however, will be constructed at Messrs. Yarrow's works, and these will serve as pattern boilers, one for each ship, so that the others may be made in Holland. The work, however, will be carried out in accordance with designs furnished by Messrs. Yarrow. Some figures furnished to us in connection with this installation will be of interest as showing the saving in weight due to the use of boilers of this type. The two cylindrical return tube boilers will weigh with water, 120 tons; while the eight Yarrow boilers with water will weigh 88 tons. In both cases firebars and fittings are included, but not chimneys. It will thus be seen that for each unit of power developed there will be required a little over 1 cwt. (1·0666) of shell boiler and water, a proportion which should give easy steaming. With the Yarrow boilers, however, the proportion of weight to power will be as 0·234 cwt. to one indicated horse power; that is to say, it will take less than one-quarter of the weight with a water tube boiler, to get a given power, than would be required with return tube boilers. An advantage of this combination is at once manifest. When only return tube boilers are used for vessels that are required to give high speeds, an effort must be made to reduce the weight in all the boilers. If, however, only a small part of the steam be supplied by the shell boiler, ample surfaces and water content can be allotted, for the extra weight thus apportioned is not a large proportion of the total boiler installation. Nevertheless, the two cylindrical boilers in the case of the ships under consideration will be sufficient for the ordinary service of the vessels, and, therefore, the virtue of durability, ease in maintaining steady steam pressure and other points which are claimed as virtues for the older type of steam generator will be maintained, but there will be a large additional steam supply to fall back upon on the exceptional occasions when it may be required. The weight of unused boiler that has to be carried about at low speeds is also small. How far it would be advisable to carry the water tube system to its full development is a matter we need not speculate upon. More extended experience in large vessels is necessary to determine this point, and the Dutch authorities have undoubtedly acted wisely in not entirely abandoning the old love before they are quite sure of the temper of the new one.

Space occupied is another point that has to be closely considered in the arrangement of warship machinery. The return tube boilers are 13 ft. in diameter by 10 ft. 6 in. long, exclusive of uptake, which adds another 2 ft. The Yarrow boilers are 9 ft. 3 in. high to the top of the casing, which, of course, includes the steam drum, 9 ft. 3 in. wide and 9 ft. long over casings. The top cylinder or steam drum, however, extends 1 ft. further at each end, the total length of the latter being 11 ft. The steam drum, however, is overhead, and does not encroach upon the stoking space. Still, with boilers against a bulkhead or back to back, the extra feet at the back end must be added, and this gives a total length required for the water tube boiler of 10 ft. The arrangement of the boilers in the Dutch cruisers is as follows: Starting from aft of the engine room bulkhead, there are first the two return tube boilers placed abreast, their axes in a fore and aft line. Next come two athwartship rows of Yarrow boilers, each having three boilers; finally, the remaining two water tube boilers are placed side by side fore and aft. As a matter of fact, the three water tube boilers occupy the same width in the ship as the two return tube boilers, and the practical length is somewhat less, so that three boilers of the Yarrow type can be got in where only two of the shell type can be placed; or, in other words, by the adoption of water tube boilers — of course of the express or small tube kind — about 3000 horse power can be put in the area required for 2250 horse power with return tube boilers.—Engineering.



WATER TUBE BOILERS FOR THE DUTCH NAVY.

FUTURE WATER SUPPLY OF GREATER NEW YORK.

ONE of the most serious problems confronting our great cities is to keep the capacity of their water supplies ahead of the rapid growth of population and water consumption and waste, and to insure a good quality as well as an ample quantity of water. When several large cities with their respective suburbs lie close together the problem becomes yet more serious, especially when both the several municipalities and the available sources of supply are in different States. Under such conditions attempts should be made to harmonize conflicting interests as far as possible, and often joint action of some or all the communities becomes advantageous sooner or later.

By far the greatest aggregation of population in the United States centers in and around New York City. There is here no lake or river of unlimited capacity close at hand to draw from. Water must be impounded at various points and conveyed through long aqueducts, or resort must be had to pumping, all at great expense. New York, Brooklyn, Newark and Jersey City are surrounded by a host of rapidly growing cities and towns of smaller size, some with manufacturing interests and others with a purely residential population. The four cities named had a combined population of 2,666,477 in 1890, while New York and Brooklyn alone claim about 3,000,000 at the present time. New York is now using about 190,000,000 gallons of water per day, and has a water supply completed and under development calculated to yield 280,000,000 gallons per day under conditions of minimum rainfall. Brooklyn used an average of about 80,000,000 gallons per day in 1895, and has a minimum available supply within its present watershed of about 115,000,000 gallons, a part of which has not yet been developed. In Newark the average daily water consumption in 1895 was about 22,000,000 gallons. The city has a contract with the East Jersey Water Company for works with a daily capacity of 50,000,000 gallons. These works have been in operation since 1892, but their capacity is now in question. As to Jersey City, the best figures available also indicate an average daily consumption of about 23,000,000 gallons. As the water now furnished is unfit for use, it may be said to have no available supply. The above figures combined indicate a present daily consumption by the four cities named of 315,000,000 gallons and an available minimum daily supply, when works under way are completed, of 445,000,000 gallons.

For the present only Brooklyn and Jersey City need concern themselves regarding increased water supplies, but New York will be at the end of its 90,000,000 gallon surplus before many years, and by 1920 Newark will at least be considering its next move, if it has not already taken it. Brooklyn is now figuring on an additional daily supply of 100,000,000 gallons, which it calculates will be sufficient for its needs until 1922 or 1923. Jersey City has long been trying to get a new supply of 50,000,000 gallons a day, but present indications are that this would not be sufficient longer than until about 1920.

In the life of municipalities 20 or 30 years is a very short time. It appears from the above that within such a brief period all four of the cities named will be at the end of present and proposed supplies. Assuming that these cities increase in population only 25 per per cent. in each decade from 1890 to 1920, their population in the latter year would be over 5,000,000, allowing for no increase in territory meanwhile. But New York and Brooklyn have annexed immense areas and some population in the half decade ending with 1895. These new districts are bound to grow rapidly in population, so that it is safe to say that the four cities will contain 5,500,000 people in 1920, within their boundary limits of 1895. To this population must be added that of a multitude of suburbs, many of which have already outgrown their present local water supplies, and practically all of which must then go to remote sources on account of the dense population which will exist on the drainage areas now in use. Some of these suburbs will be, through further annexation, parts of the four larger bodies politic under consideration. For purposes of water supply, and possibly other public services, a Greater New York will then be a necessity,

provided it has not already become a reality by actual consolidation. Of course the New Jersey section of this great metropolis will remain politically separate, but physical necessities will at least suggest that harmonious action and co-operation in some things with the portion of the metropolis lying across the North River might be mutually advantageous. If only 500,000 people are allowed for in the suburbs, there will be 6,000,000 within metropolitan New York in 1920. It will require stern restrictive measures to so restrain the increase in the per capita consumption of water in progress for 20 years that it will not exceed an average of 100 gallons in 1920. But, assuming that this can be done, our 6,000,000 of people will require 600,000,000 gallons of water at that date. As shown above, a new or additional supply for all these people will then be necessary, and a provision would naturally be made for 30 years in advance. Assuming only 20 per cent. increase in population for each decade, it would be necessary to provide for 10,370,000 people, or more than a billion gallons a day, assuming the per capita consumption to remain at 100 gallons until 1950. A more careful study might show a greater population to be provided for in the year named, and it would take but few figures to show that only by heroic measures can the per capita consumption be kept down to the figures named for so long a period, judging from past experience.

Let us come from this very general discussion of facts, probabilities and possibilities to the concrete case of Brooklyn, whose officials are considering and must very soon provide more water. The local situation has been clearly set forth by Mr. I. M. De Varona, M. Am. Soc. C. E., Engineer of Water Supply. As to the possibilities for the future, Mr. De Varona reports on obtaining 100,000,000 gallons daily from the southern slope of Long Island, going farther to the eastward and taking a drainage area adjacent to that now in use. Mr. Wm. Worthen, Past Pres. Am. Soc. C. E., reports on a supply of like amount from the headwaters of the Housatonic River, on the east side of the Hudson, and from the Ramapo, on the west side of the Hudson.

We will not undertake a detailed discussion of the relative merits of these three plans, but in view of the future needs of the metropolitan district, set forth above, it seems desirable to consider the subject briefly from that point of view. And first it must be pointed out that the Housatonic and Ramapo schemes contemplate the diversion of large quantities of water from these rivers before they flow into the States of Connecticut and New Jersey, respectively, thus involving the question of interstate water rights. However Connecticut may look upon such a plan, it seems certain that New Jersey would fight it, no little opposition having been shown some ten or twelve years ago, when it was proposed to divert the Ramapo in a similar manner for the supply of New York City. Aside from this, or rather connected with it and accounting for some of the opposition, is the claim that New Jersey cities and towns need all the highland streams of the State, and especially the headwaters of the Passaic, for their own supply. Next it is to be observed that nearly twenty years ago New York City made surveys of the Housatonic drainage area, and that the waters here available, provided the interstate questions can be amicably settled, may perhaps belong to New York on broad grounds of public policy, since it is claimed that at small expense they may be turned into the Croton watershed. As the two Croton aqueducts have a carrying capacity in excess of the minimum daily yield of the Croton drainage area, the Housatonic might prove to be a most valuable supplement to the Croton.

A portion of the available supply from the Housatonic could of course be used by New York without raising serious interstate questions, and this might be feasible for New York while not at all so for Brooklyn.

The Housatonic plan for Brooklyn involves a submerged crossing from the main land to Long Island beneath Bronx Kills, Little Hell Gate and Hell Gate. The Ramapo plan includes the same crossing, and, in addition, a 6,000 ft. crossing beneath the Hudson. It is proposed to lay cast iron pipes on the bed of the channels for each crossing. It is a serious question whether tunnels would not be far preferable.

The only reasons for going off Long Island, for a supply of the proposed amount, would seem at first thought to be because water enough could not be found otherwise. But Mr. Worthen estimates the cost of the Housatonic plan at $18,382,000 and the Ramapo $14,630,000, while M. De Varona's estimate for a supply from Long Island is $24,500,000. The annual charges for the three plans are put at $726,000, $589,000 and $1,425,000 respectively, the Long Island scheme having not only the heavier interest and sinking fund requirements due to heavier capitalization to meet, but nearly $400,000 of pumping expenses in addition.

The annual cost per 1,000,000 gallons under the three estimates is $39 for the Long Island, $20 for the Housatonic and $16 for the Ramapo. On this basis alone the Ramapo plan would be the one to adopt. But taking into account the uncertainties attendant upon the appropriation of water which other States may claim, the difficulties involved in effecting the river crossings, the fact that the Long Island plan is far more susceptible than the others of development as the need for more water arises, and that the pumping expenses would be closely related to demand, it may be that the difference between the cost of the Long Island and the other plans is more apparent than real. Mr. White urges in his report that these and other reasons may bring the cost of the Ramapo and Housatonic schemes quite up to the actual cost of the Long Island, the estimates for which he considers high.

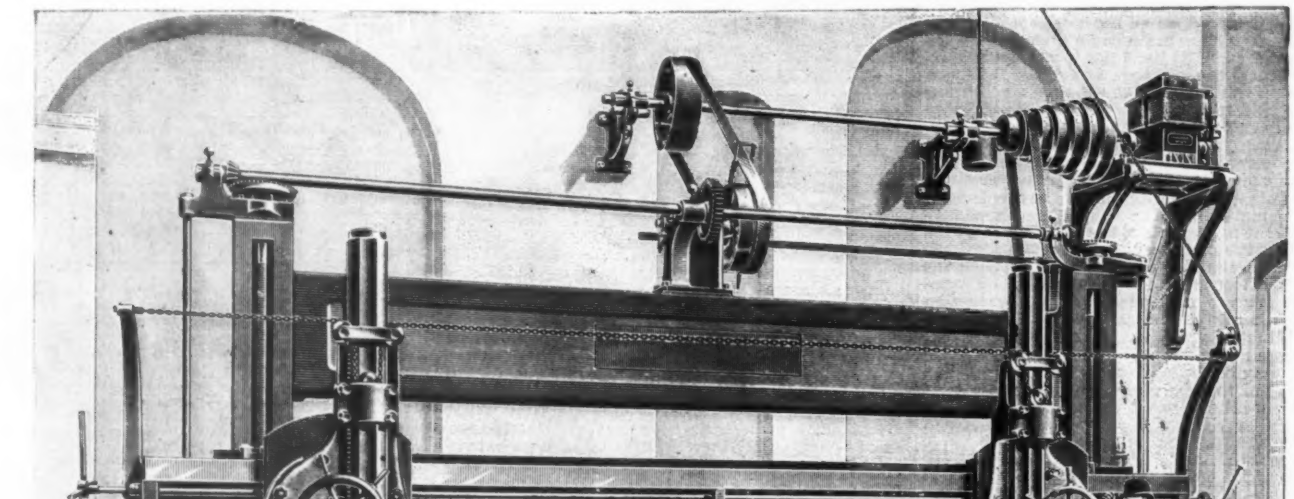
Whatever may be said regarding the relative costs of the island and non-island plans, $39 per 1,000,000 gallons is not an excessive figure for water, and there are strong reasons why Brooklyn should exhaust local resources before going elsewhere for its water supply. In the first place, all available sources of supply will eventually be needed for the metropolitan district. By the time those near at hand have been developed it may be that some co-operative scheme will be possible, or at least some line of action which will avoid, so far as possible, all clashing of interests. It is easy to suggest that each municipality may look where it chooses for a present supply and all join together in the future. Present action should be in harmony with future probabilities. Moreover, it must be remembered that other centers of population must be supplied, aside from Greater New York.

For instance, Mr. White suggests that a supply of 1,000,000,000 gallons a day might be secured for the metropolitan district from the Delaware River. Years ago the upper Delaware was suggested as a proper source for Philadelphia. Many New Jersey towns, some of considerable population, are now drawing from the lower reaches of that river, which might advantageously join with that city in going to a point nearer the sources. The upper Hudson, Lake George and Lake Champlain have been mentioned as possible sources for New York's supply; but Albany, Troy, and other cities in that vicinity are now drinking sewage polluted water, and, with other communities in that section, may yet appropriate a large part of any supply which it would be at all feasible to bring to New York.

It must be evident to any one who gives this great subject of future water supply careful thought that some means must be devised by many of our cities, and especially for those in the Greater New York district, to decrease the enormous waste of water now so common. The water consumption per capita in such of our larger cities as had public supplies from 30 to 50 years ago has increased from two to four times. The waste of water must be reduced. Even Brooklyn, with a per capita consumption of 79 gallons, could doubtless reduce this figure by an extension of the meter system. Could it no more than hold it down to the present point for a few years, the necessity for a new supply would be diminished.

The subject treated above is so broad a one that it has been impossible to do more than point out a few of the questions involved. Perhaps enough has been said to make it plain that any extensions to the water supply system of the cities making up the Greater New York should be conceived on broad lines with regard to mutual needs and requirements; and, in addition, that it is quite as essential to so supervise the consumption and waste of water as to keep the latter down to the lowest figure as it is to lay out great schemes and secure the introduction of additional supplies.

The work of checking waste and curtailing needless consumption is a monotonous task, and the engineers who carry it out are apt to reap nothing better than maledictions, whereas professional fame and honors await those who plan and carry out great works for the increase of present supplies. Nevertheless, every careful student of the problem must admit that the work of checking waste and economizing the available supply of potable water is that which effects the greatest public benefit.—Engineering News.



HEAVY TURNING AND BORING MILL.

EIGHTEEN FOOT HEAVY TURNING AND BORING MILL.

THE 18 ft. heavy turning and boring mill which we illustrate on this page, from the London Engineer, is the largest of a series of useful machines of a new type brought out by Messrs. Smith & Coventry, of Gresley Ironworks, Salford, Manchester, England. These machines, which possess several distinct advantages, are made in sizes to admit work ranging from 1 ft. 6 in. to 18 ft. in diameter, and are taking the place of the larger face plate and chucking lathes. It is claimed for these machines that they are capable of doing from one and a half to six times the amount of work in a given time which can be done by ordinary face lathes, considerable time being saved in chucking the work. The table, which is driven by spur gearing, is attached to a massive vertical spindle which is carried in the bed and receives all lateral thrust. It is further supported near the periphery by a broad annular bearing which is self-oiling. The larger mills of the series have an arrangement for raising the table off its outer bearing when it is required to run at an accelerated speed. The speed cone and gearing are correctly graduated to give the table the proper cutting speed for all diameters, the position for the belt being indicated under the driving cone. The machine has a heavy cross slide, which is raised and lowered by power on the uprights. It carries two heads, which are quite independent of each other, and can be controlled from

either side of the machine. The uprights are rigidly set, being bolted and gibbed to the bed of the machine, and stayed together at the top by a cross stay of deep section. The heads are made right and left hand, so that the tool bars may be brought close together. They have self-acting and hand traverse by screw in either direction along the cross slide, the larger machines having a quick hand traverse by rack and pinion. The tool bars are octagonal in section, and each bar is carried on its saddle in a swivel slide controlled by worm and wheel. The traverses of the tool bars are independent and automatic in all directions, and the bars are counterbalanced, so that they travel up or down with equal facility. There are separate and independent feeds for each head and tool bar. By this means variations of feed may be given to the heads, either in the same or in opposite directions on the cross slide. The tool bars may also be fed independently of each other, either up or down or at an angle.

The 18 ft. machine which we illustrate was built for Messrs. Siemens Brothers & Company, and was put up at their works at Woolwich, where it is giving every satisfaction. It is driven by electricity, as will be seen on reference to our engraving, where the motor is shown at the top, on the left proper of the machine. The motor is a Siemens two pole H. D. $\frac{1}{15}$, giving about 6 brake horse power at 175 revolutions. It is coupled direct to the countershaft, and fitted with a reversing switch, to avoid the necessity for open and crossed belts, with the accompanying loose pulleys and striking gear, the whole forming a very compact and handy arrangement. The switches are so arranged as to be easily operated by the attendant. By the arrangement of running the face plate on a circular race, great solidity is obtained and very heavy cuts can be taken. No matter how much the work is out of balance, no counterbalancing is required, thus saving much time. A number of similar pieces of work can, moreover, be easily and quickly disposed around the horizontal face plate, and all simultaneously turned. In fact, the advantages of this machine over lathes with a horizontal spindle and a vertical face plate are very pronounced for many kinds of work, especially of the heavier and not easily fixed forms.

ELECTRIC PROPULSION BY SUBTERRANEAN CONDUCTORS.

ELECTRIC propulsion by subterranean conductors is certainly one of the most difficult problems that is at present submitted to electricians.

Aerial trolleys furnish a very simple solution, and a most advantageous one, of the question of propulsion, despite the few difficulties that have risen apropos of the phenomena of electrolysis produced by the current returning through the rails. But overhead trolleys are not always applicable in large cities, or at least only so in the outskirts, where the need of them is less pressing than in the center of the city.

Electricians have, therefore, been forced to look for a system of subterranean conductors, of naked wire, established in conduits, and upon which contacts carried by the automobile car should rub. It was, therefore, necessary to leave an opening for the passage of such contact. As this was to afford an entrance for water, mud, and the various kinds of filth found upon public streets, there was no certainty that the contact could be kept in proper condition. All the inventions relating to this subject that have been brought forward have, therefore, had for their object the creation of a system of subterranean wires in which the communicating cables should be protected against external objects capable of entering through the central slot.

Such systems are now very numerous and we can in this place pass in review only the most important of them. But at the outset we shall establish a very distinct division, and distinguish:

(1) The systems of continuous contact by the friction of a trolley; and

(2) Those of contacts distributed upon different points by various devices.

These are two divisions that we are going to study in succession. The systems of continuous contact by the friction of a trolley are the more numerous, and, up to the present, among the principal ones, we know the following:

The Holroyd Smith, the Siemens & Halske, the Love, the Jenkins, the Griffin, the Munsie Coles, the Johnson, etc. In almost all these systems the conduit contains only the secondary conductors. The feeders are placed at the side or in the vicinity. The return is effected through a second conductor, and no longer through the rails, as in the overhead trolleys.

The Holroyd Smith system, represented in Fig. 1, was applied in 1885 upon the Blackpool tramway, in England, and has operated up to the present without any great amount of wear and tear. From 1885 to 1892 it was operated by a private company, and since the last named period has been in the hands of the city.

The conduit is of iron plate, fixed to a rail and resting upon a series of metallic supports. Wooden crosspieces placed in the upper part of the conduit support porcelain insulators which hold the cable. The lower part of the conduit is capable of receiving rain water without any damage to the cable. At intervals along the conduits there are situated drainage wells. In the first models the conduit was placed in the middle of the roadway.

With the system of which we are going to speak, it was necessary to establish two conduits, one on the up and one on the down track. So the inventor devised another model (Fig. 2) with a single large conduit, 5½ ft. in height, for the two tracks. This large conduit, like a sewer, permits of the passage of a man. The maintenance and cleaning of the cables and contacts can, therefore, be assured under the best of conditions without any fear of the accumulation of mud and water. It is this latter system that has been preferred for Paris, and a concession has been granted for the establishment, with this large conduit, of an electric line from Place Cadet to Place Montmartre. The advantages of this system are numerous, and thus are done away with all the inconveniences that might attend the use of small conduits. The cost is, perhaps, greater, but the question involved is one of a practical solution, rather than one of cost.

In 1887, the house of Siemens & Halske established at Budapest the system represented in Fig. 3. The subterranean conduit is formed of cast iron frames of oval section, connected by a concrete channel of the same section. An aperture at the upper part communicates with the slot in the central rail. Upon the frames porcelain insulators are carried horizontally for holding the cables. This system has been exploited at Budapest since 1887.

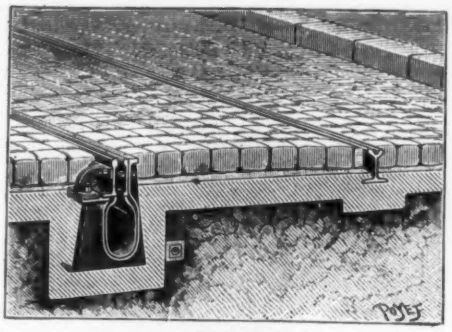


FIG. 1.—THE HOLROYD SMITH ELECTRIC CABLE CONDUIT.

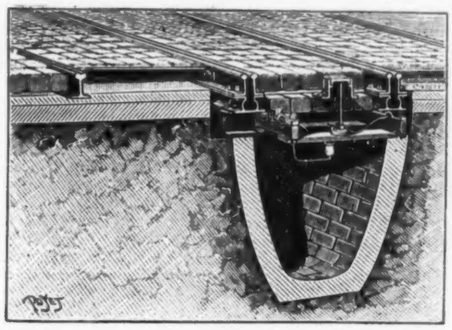


FIG. 2.—MODIFICATION OF THE HOLROYD SMITH CONDUIT.

There are now four similar lines supplied by a single station. The results furnished have been satisfactory. The opinions of various engineers as to the practical value of this system have, nevertheless, been very different. In 1894 the engineer-in-chief of the city of Newcastle said that the slot provided for the passage of the conductor was 1½ in. or 2 in. in width, and that such a width would be the cause of serious inconveniences in ordinary streets, in which wheels with narrow tires might enter the slot and cause short circuits. Mr. Launay, on the contrary, thought that this subterranean conductor appeared to constitute a very happy solution of the problem of electric propulsion in large cities. Mr. Henri Marechal aptly remarks that the conductors and their supports cannot be inspected without tearing up the roadbed.

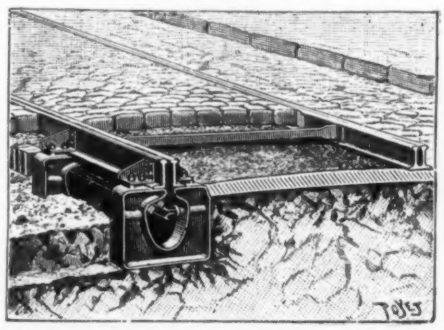


FIG. 3.—THE SIEMENS & HALSKE SYSTEM ESTABLISHED AT BUDAPEST.

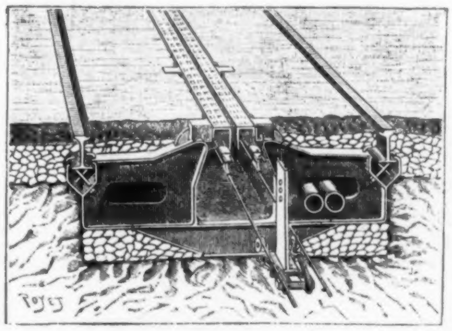


FIG. 4. THE LOVE SYSTEM APPLIED IN THE UNITED STATES.

This would be a serious inconvenience for Paris. Moreover, at Paris, the director of public works will not accept a slot wider than one inch. The roadways support very heavy loads, the wooden pavement gives strong thrusts, and it might happen that the slot should contract so as to prevent the passage of the rubber. Mr. Charles de Tavenier fully shares this view and tells us that in the exploitation one would be undoubtedly exposed to the deepest disappointment in adopting at Paris (save in narrow streets or at special points) either the small subterranean conduit employed in the Budapest type, even were it improved, or the Blackpool conduits.

Among other systems we may mention that of Love (Fig. 4), adopted in America. It consists of a subterranean conduit formed of separable cast iron plates. Two wires are supported by insulators at the upper part. The rubber is a carriage with two grooved wheels pressing upon two wires. The feeders are placed at the side. The results obtained at Chicago and Washington up to the present have not been very favorable. So in a part of the last named city a modification of the Budapest system has been adopted, the insulator being fixed vertically and not horizontally.

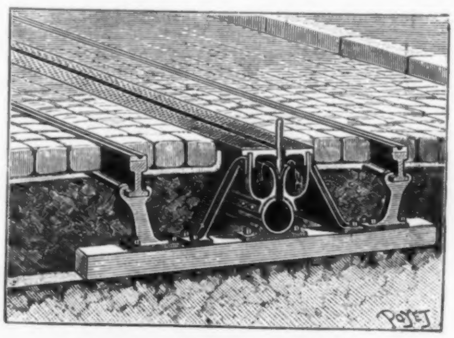


FIG. 5.—THE ZELL SYSTEM.

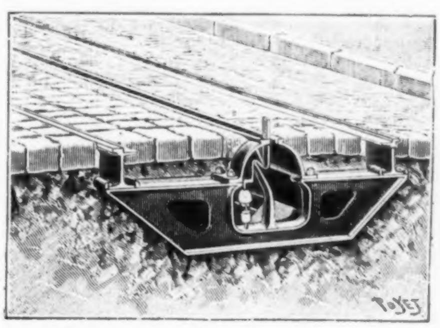


FIG. 6.—THE GRIFFIN SYSTEM.

The Zell system (Fig. 5) consists of a conduit divided into three parts, two above for the reception of the cables, and one below (in the prolongation of the central slot) for collecting the water and mud. The contacts are carried by a central rod with two curves entering the parts of which we have spoken.

The Griffin system (Fig. 6) consists of a cast iron conduit, divided into two parts, one carrying the cable, upon which rests the contact connected with the central rod by a bent support, and the other serving for drainage.

The Hoerde system (Fig. 7) is a modification of the Love. It consists of a cast iron conduit, provided at the top with a longitudinal recess, in which the conductor is fixed upon insulators. The contact is assured by a special plate fixed to the car and passing through the slot. In the Petersen system (Fig. 8) the two conductors are established in a part of the conduit that is entirely closed. The cover consists of a flexible

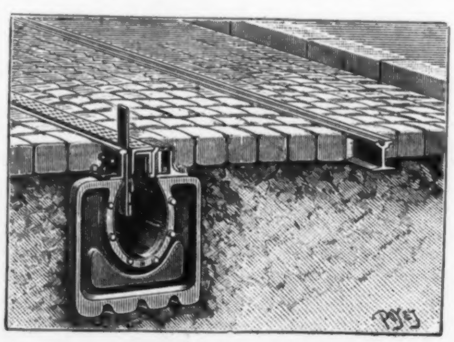


FIG. 7.—THE HOERDE SYSTEM.

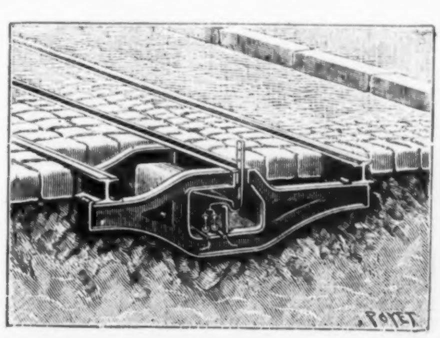


FIG. 8.—THE PETERSEN SYSTEM.

piece, which rises for the passage of the bent rod that serves to establish the contacts.

Such are the principal systems of subterranean conductors in conduits for electric propulsion.

Along with the systems of continuous contact by the friction of a trolley there are, as we have above said, systems of contact distributed over different points by means of various devices. Among such systems, we may mention the Lineff, the Van Depoele and the Claret-Vuilleumier. Not long ago the Westinghouse company also devised an electro-magnetic tramway.

In the Lineff system the current is sent, during the passage of the car, to parts of insulated rails placed in the center of the track. This result is obtained by means of a powerful electro-magnet, which lifts a flexible iron bar. Analogous arrangements are found in the Van Depoele and Westinghouse systems, no application of which in practical operation is as yet known.

Of the Claret-Vuilleumier system we have already described the principal arrangements adopted in the installation at the Lyons Exposition. The last preparations are under way at Paris at this moment for the setting in operation of a line installed according to this system from Place de la Republic to the gate of Romainville.

In order to complete our notes, it would be necessary to give the costs of establishment; but the expenses are very variable, according to the line.

What we have just said shows that electricians are as yet far from being decided as to the practical value of these different systems.—La Nature.

THE TRAINING OF CIRCUS DOGS.

I REMEMBER that in my childhood I considered learned dogs as superior creatures, marked with the seal of genius, that jumped and danced for their own

pleasure, for glory and perhaps, to a certain extent, because they took pity on the poor devils who served as their showmen.

The public, doubtless, is not possessed of so romantic illusions, but it scarcely suspects the difficulties of every nature that the exhibitor of dogs meets with. As a general thing, it is thought that the wonderful intelligence of Azor, encouraged by a few lumps of sugar given at the proper moment, permits the trainer to obtain everything from him in the easiest manner possible.

On this subject, I have obtained the confidence of an old stager, who for many years exhibited learned canines throughout the world. "Never," said he to me, "have I given my show in a city without meeting with the citizen proud of his dog. He awaited me at the close of the show, accosted me very politely, invited me to 'take something' with him, and then it was always the same old talk: 'My dear sir,' he would say to me, 'your pupils are admirable. I adore dogs and I come to applaud you every evening. I myself have a little terrier; and what a beast, my dear sir! Ah, if he had only fallen into your hands! I, you understand, have no time to bother with such things, but I would be willing to bet that in a week he would do all

that yours do! Here, Tom! Come! Jump! [Tom does not jump.] Ah, if it were at home! This animal is a perfect wonder! He goes to fetch my slippers! Tom! fetch my cane!' [Tom doesn't budge. Then his master, in a rage, gives him a kick. But that is no matter; Tom is a treasure.]

"The dog is certainly capable of receiving a very complicated education. Yet, were one to depend solely upon his intelligence he would run a great risk of getting nothing out of him. It is possible that, in playing, your bowwow may take pleasure in obeying you, but require of him a little more precise work, and his sense is gone. The intelligence of the dog is a resource that he begins by utilizing in order to defend himself and he employs it with desperate address. It is only in the long run and almost always after a series of corrections that he feels the necessity of obey-

ing and decides to execute the motions that he has no desire to perform. After this, his greatly developed intellectual faculties become, in fact, a channel through which you will slowly impress a certain number of talents upon him. All that he will be able to understand you will now only have to make him repeat a great number of times (in using gentleness if possible, and presents of cake if you are so disposed, although, theoretically, this is not indispensable) in order that he may succeed in executing it with automatic exactitude. This is the persuasive method.

"I say that he will act with 'automatic' exactitude; for, when he is exhibited in public and performs the most difficult feat, and the one most intelligent in appearance, his reasoning faculties will no longer count for anything in it at the time. The series of motions that constitute such feat will have become instinctive and mechanical, and he will act without his will counting for anything therein; just as one has learned

to play the piano in applying his reason, and just as one has finally acquired the series of reflexes that permits him to perform an air without looking at his hands.

"By persuasion you may teach a dog to walk upright, roll a ball, balance himself upon a bottle, etc., but, whatever be the relative intelligence of the subject, there are some things that an animal will never learn. You will never make him understand in what a somerset consists. It will therefore be necessary to employ force here. By means of a lunge and different apparatus, you may put the beast in a series of positions that he must assume, and at the end of a certain length of time he will repeat in liberty, at your command, what you have taught him by this method, which is somewhat brutalizing, even to the trainer himself. It is also the method that gives the most room for violence, but no one can get around it.

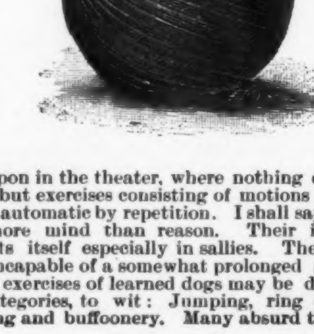
"To resume, training, properly speaking, is therefore a compromise between persuasion and the use of force, and you see that learned animals are beasts upon which a sort of mania has been impressed by word and gesture (persuasion), or else by the cord and such appropriate carcars (coercitive method). Every exercise, the somerset, for example, becomes a sort of knack. I have known a little griffon that could not make any other jump but this. If he tried to leap over a cane placed in front of him, he immediately started off into 'somersets backward,' as they say in the slang of the profession. Another example no less convincing is the following: When Madam Dore trained the dog that created the serpentine dance, the poodle became so accustomed to waltzing in luminous projections that it was impossible to strike a match without the dog's standing upright and turning.

"The well known exercises that seem to somewhat contradict our theory and appear to prove the existence in the dog of an extraordinary discernment exercised under circumstances not regulated in advance, such as the exercises of Munito, who played cards with a spectator, made calculations and formed words, are all simply accompanied with a touch of charlatanism and stage mechanism. It would require a large volume to explain such tricks of the trade. Let us sim-

ply say, from a theoretical standpoint, that in this exercise the dog passes around cards arranged in a circle and that the trainer or a confederate stops him before the one that he is to play, either by a snap of the nail, or, as was the case with Munito, in causing the ascent of keys placed in the floor and hidden by a carpet under the dog's paws. So too, one would be greatly mistaken to regard a number of exploits, due to simple scent, as the result of connected reasoning.

"This faculty, which permits your bowwow to find an object lost in darkness, and to follow in an opposite direction a road already traversed, and that too with more precision than could be attained by a human being, appears surprising precisely because we are totally devoid of it. But it is purely animal and instinctive.

"Note this well. I in nowise think of denying the greatly developed intelligence of man's best friend. He undeniably possesses a very excellent memory, and has visions of things, as well as ideas, and, better still, associations of ideas that are true reasonings. These, however, are flashes of intelligence that could not be



relied upon in the theater, where nothing can be exhibited but exercises consisting of motions that have become automatic by repetition. I shall say that dogs have more mind than reason. Their intelligence manifests itself especially in sallies. They are ordinarily incapable of a somewhat prolonged reflection.

"The exercises of learned dogs may be divided into four categories, to wit: Jumping, ring evolutions, balancing and buffoonery. Many absurd things have

been written in explanation of the methods of professionals. It seems, even, that the latter have made it their business to maliciously disconcert the curious. Being particularly well informed upon this subject, I shall speak of all this at another time. All that I desire to do now is to consider the question in an attractive light. Let me speak of clown dogs.

"Buffoonery, like all the exercises in which the intelligence of the dog appears to come directly into play (although there is here only a particular 'mise en scene'), has the good fortune to win applause.

"The tritest consists in ostensibly urging the four footed clown to jump through a hoop or over a bar and then apparently falling into despair at seeing him pass beneath. I have never found this particularly brilliant, but the fact is that this pleasantry is greatly

relished by the public. At evening entertainments it is one of those effects that is sure to cast allusions to the mother-in-law in the shade. However, it is no more difficult to obtain this feint than it is the ordinary jump. It suffices to hold the pupil in check with the leash.

"When your clown has considerable facility of conception, you can make him walk upon the stage almost alone and repeat behind your back the exercises that another dog is executing under the whip, so that he appears to ape the latter animal. The spectators go wild over such things.

"As regards the parody of the serpentine dance by a dog, I was the first to conceive the idea of that, and even presented Madam Doré with the dog that was necessary to realize it. It is a poodle that I can recommend to you. He ascends four ordinary steps upon his hind legs, like a little man, and, at the first landing place, I make it my business to cause him to waltz for five minutes. All the newspapers have celebrated the debut of Dick at the Theatre des Nouveautes. Do you recall the first representation of Messrs. Blum & Toche's 'Paris qui Passe'? The confederate (Mr. Germain) was at the inevitable couplet upon serpentine dances, when all at once the footlights were extinguished and there was seen approaching with mincing steps an enigmatic Salome in a gown with a golden waist. A cry arose in the hall: 'But it is a dog!' In fact, what a strange Salome she was! Her chin was bearded and her eyes shone curiously under her blond doll's wig. The orchestra struck up the Loie Fuller Waltz, and the dancer began to spin around and soon disappeared under the folds of her skirt of Iris, which was successively illuminated with red, blue and violet, and then re-entered the side scenes in making six foot jumps that threw the skirt back in a bunch upon the loins and revealed two hairy legs, and finally a tail upon which the shearer had left a pretty tuft of hairs of the most beautiful Astrakan.

"Madam Doré obtained the play of the skirt by processes analogous to those employed for boxing. To the fore paws of Dick she attached bracelets provided with bells, which the animal shook instinctively. This was one motion, and it was necessary to regulate it (something that required more than a day), and finally to replace the bracelets by the wands of a serpentine skirt.

"In our time it is so difficult to make an innovation, in no matter what order of ideas, that I perfectly understand the reasons that led Madam Doré to have the tribunal of commerce of the Seine condemn 'Professor' Richard, an indelicate imitator, who, abusing the claim of being a citizen of Toulouse, styled himself the creator of this attraction, although he had copied all the details of it a year after its appearance. Do you know that since the exercises of Munito, but a single striking one had been created: The somerset?

"Madam Doré has a sensational novelty in store

for us for this winter. We shall see a Hercules dog that lifts twenty pound dumb bells and finally carries, while standing erect, a gun whose formidable detonation will make a person close his eyes. Hercules, as companions, will have dogs that maneuver plates and bottles and hold a lighted lamp upon the head while they are waltzing upon their fore legs."—P. Hachet-Souplet, in L'Illustration.

CLOCKS IN THE MIDDLE AGES.

THE precise date of the origin of the house clock is quite obscure. Nevertheless, we can prove by the documents upon the subject that have reached us that it was employed at the same time as the tower clock. Thus, we can compare the clock of the bridge of Caen, which was put in place in 1514 and is one of the first known, with the house clock mentioned in the inventory of Philip le Bel, who reigned from 1285 to 1314: "A clock entirely of silver, without iron, and with two counterpoises of silver filled with lead, which belonged to King Philip le Bel."

There are two means offered us of studying the clocks dating from the past ages: in the first place, the representations of them, and, in the second, the original pieces. We find representations of clocks in works of art of all sorts—in sculpture, in painting, in engraving and even in tapestries.

The dates of such documents offer valuable information as to the date of the clocks themselves. When the original pieces are dated, the study of them is easy, but this is not always the case. It is then that it is necessary to take into account the persistence of traditions in order that we may not fall into gross error.

We possess neither any description nor any document that indicates to us the form of clocks in the fourteenth century. The inventories alone that have reached us reveal their existence in indicating the materials of which they were composed, as well as their weight and ornamentation. The most precise documents do not begin till the following century. If we are forced to proceed by supposition relative to the clocks of the fourteenth century, we have a right to think that they were very beautiful, since good taste prevailed at the epoch and since goldsmiths and skillful ironsmiths were not wanting. As such pieces were designed only for the greatest lords, one necessarily had to try to ornament them as much as possible. We find a proof of their rich character in the materials that composed them, for gold, silver and precious stones were employed in their construction.

Thus, in the inventory of the furniture and jewels of King Charles V, begun on January 21, 1379, we read: "A clock of silver placed upon a pillar that is called 'orlogium athas,' weighing 3 marks, 3 ounces and 5 sterlings." Up to that time, it was kings and princes only that owned clocks. The first private person who had one was, it is said, an astronomer named Waltherus, who made use of it in 1484 for his observations.

The striking train was very probably employed in

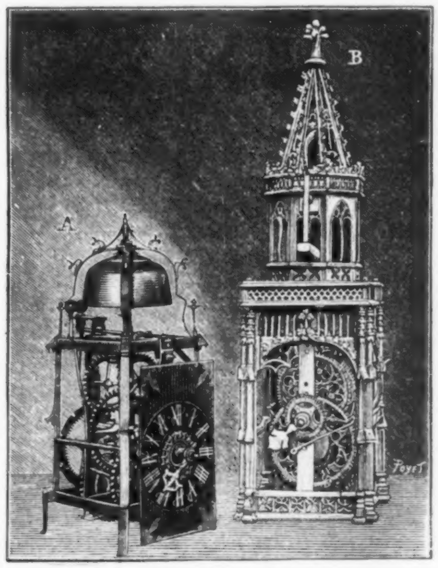


FIG. 1.—A. CLOCK WITH A CASE. B. CLOCK WITH OPEN-WORK SIDES.

house clocks from the beginning. Almost all clocks were provided with it in the fifteenth century. In 1420, Philip le Bon had "a little square clock of gilded silver enameled with the signs of the zodiac, and with a bell at the top to strike the hours." Starting from the fifteenth century, sufficiently numerous documents will permit us to study the forms and decorations of the clocks to a certainty, since we can therefore put under contribution the two sources of information spoken of above.

Primitive clocks did not always have cases containing the movement. A simple iron framework held the wheelwork and the dial that covered the front (Fig. 1, A). The one that we represent here forms part of our collection.

Seeing the clumsiness of the wheelwork, a perfect covering was not necessary, for the dust could have no action upon it. And then the workmen who constructed the clock must have been quite desirous of allowing their work to be admired. In some cases the dimensions of certain wheels were such that they extended outside of the case and prevented the movement from being inclosed. We find examples of this

FIG. 2.—CLOCK WITH OPEN-WORK SIDES.

in the clock of an ancient manuscript of the National Museum, in a vignette of a picture of civilization dating from the close of the fifteenth century, and again in a manuscript of the same epoch belonging to the library of Rouen, "The Ethics of Aristotle."

The sides of the case of other clocks were entirely in openwork. Such pieces are remarkable by the richness of their ornamentation. Such, for example, is the one still existing in the museum of Bourges (Fig. 1 B) or the one that we have detached from a very beautiful tapestry of Van Eyck (1395-1440) representing the history of the Virgin (Fig. 2), and in which an allegorical female called Temperance holds a clock in her hands.

At the end of the fifteenth century we find clocks that are entirely closed, like the one held in its hand by the statue of Temperance, which adorns one of the

angles of the tomb of Francis II. at Nantes (sculptured by Michael Colomb, who lived between 1431 and 1512), and from which we have detached the clock shown in Fig. 4. Speaking of Temperances with clocks, we must here give another example. Christian iconography teaches us that, starting from the fifteenth century, Temperance, the cardinal virtue, is nearly al-

FIG. 3.—CLOCK FROM THE FACSIMILE OF A MINIATURE IN A MS. OF THE ROUEN LIBRARY.

ways symbolized by a female holding in most cases a clock in the hand, as we have just said, or else carrying it upon the head (Fig. 3). With the other hand she holds a bridle or a sort of double eyeglass. Sometimes again the bridle and bit are placed upon the female's head. Previous to the fifteenth century, this

FIG. 5.—TEMPERANCE OF THE TOMB OF GEORGE D'AMBOISE.

same virtue is always represented by a female, but with different attributes. Thus, in the Museum of the Louvre, there exists a marble statue of the Italian school of the fourteenth century representing a Temperance holding a bouquet of flowers in the hand. We may add to these details that, during the seventeenth century, the clock begins to disappear, but the female

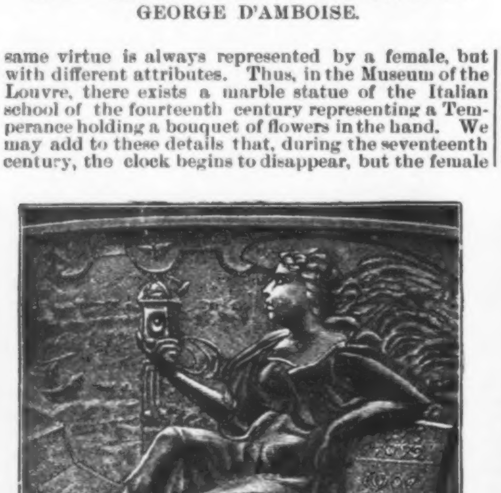


FIG. 7.—ARITHMETIC. (From tin plate of Francis Briot.)

nevertheless preserves the bit. Such is the statue of Temperance of the funereal monument of Henri de Longueville, sculptured by F. Auguier, in the Museum of the Louvre. On another hand, the National Library possesses some engravings representing Temperances without clocks. The attributes that they hold are flowers, the bridle, the eyeglasses, etc.

FIG. 4.—CLAUSE CLOCK (TOMB OF FRANCIS II).

Our researches in this direction have led us to discover here a source of information that we have put to profit for the history of the forms of clocks that we have undertaken. In sculpture we have found it in the tomb of Louis XII, at Saint-Denis, in which the statue holds a clock with the arms of France; in the

FIG. 6.—TEMPERANCE OF A MADRID TAPESTRY.

tomb of George d'Amboise, at Rouen (Fig. 5), sculptured by Rolland le Roux (1516–1525); in the rood loft of Limoges (constructed between 1533 and 1535); in the facade of the castle of Ussen, at Echebrune (1530–1550); in the cathedral of Amiens, upon a tomb; in the pulpit of the Church of Saint-Etienne-du-Mont; in the tapestries of the palace of Madrid (Fig. 6); and in

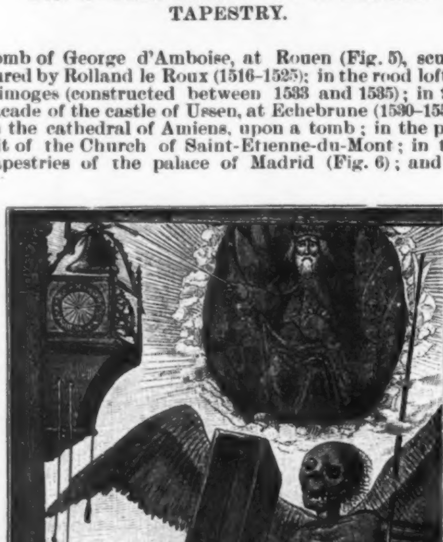


FIG. 8.—CLOCK FROM A MS. OF THE FIFTEENTH CENTURY.

the combats of the Vices and Virtues, by Jean de Maubeuge, derived from the castle of Duerstade, owned by Philip of Bourgogne, Bishop of Utrecht, and which represent the road of the Honors, Vice, Justice and Faith.

Arithmetic also was symbolized by a female holding a clock (Fig. 7). This emblem is found in the Museum of the Louvre in a tin plate forming part of the Sauvageot collection, and another is found in the decoration of a horizontal clock, signed "Levy, Aix-la-Chapelle, 1620," at the Kensington Museum of London. In the Museum of the Louvre there is a picture by Paul Veronese (1528–1588) representing a standing female having a man under her feet. The legend reads: "Virtue throwing Vice to the Ground." The female holds a clock in her two hands.

All these clocks are relatively small (about from 10 to 20 inches in height). Those that we have found in the representations of various scenes in paintings confirm this fact, according to the proportions of the persons figured.

Clocks were usually simply suspended from the wall, although some were placed upon a support. In a manuscript of the end of the fifteenth century belonging to a Parisian collector, the Marquis de Panisse, we have seen a miniature representing the last judgment, in which there is a clock placed upon a support or bracket provided with an aperture for the passage of the cords that suspend the weight (Fig. 8). This clock, which is of somewhat heavy aspect, is of iron, and the wheelwork is visible at the side. The dial, which occupies the entire face, consists of a disk painted red, with the twelve hours in white. The center of the disk is blue, with a rosework of gold.

It is therefore established by all that precedes that the clock as long ago as the fourteenth or fifteenth century had reached its highest degree of artistic and decorative interest, that it was then constructed of the most precious metals, and then of iron in the most wonderful manner, and finally that copper, either chased or repoussé, was employed in it.

It is to be remarked that in all the clocks of these primitive times there was no endeavor made to conceal or misrepresent the destination of the object by a peculiar ornamentation. The dial was large and allowed the time to be distinctly seen, and the clock glass was proportioned to the case and well arranged for preventing the sound of it from being diminished.

It was during the fifteenth century, under the reign of Charles VII, that the spring was invented as a motor. This led to a profound revolution in the destination of clocks, since they thenceforth became portable. But that had no influence upon their form, and the clock was always the same, whether it was run by a weight or a spring.

No original spring clock of the fifteenth century has come to our knowledge, and as for illustrations, they are not to be consulted, since, as we have already said, the spring had no influence upon the form, and it would consequently be impossible to distinguish one from another in a picture. The spring clock must have been very rare at the epoch, seeing the difficulty of manufacturing the spring; and since such pieces must have run less perfectly and have cost more, it was necessary that the manufacture of this part should be improved in order that the use of it should become more frequent, and this is something that did not take place until the following century.—M. Planchon, in La Nature.

[ENGINEERING AND MINING JOURNAL.]

THE MINERAL AND METAL PRODUCTION OF THE UNITED STATES IN 1895.*

THE METALLIC PRODUCTION.

THE metallurgical production, representing the results of the mineral industries in finished form, attracts the most general attention.

Aluminum.—The output of aluminum increased about 10 per cent., owing to an improvement in the manufacturing facilities of the only active producer. The use of this metal in the arts is growing slowly, though it is still limited by the high price.

Antimony.—An increase, large in proportion though not in actual amount, is reported in the output of this metal. Its history for 1895 has been a record of a moderate growth in demand, a more rapid increase in production and a consequent lowering in prices.

Copper.—The production of this metal in 1895 amounted to 175,294 metric tons (386,453,850 pounds). Thus the output, which showed an actual increase in quantity, even during the years of depression, again displayed a steady growth, and the increased demand at one time during the year forced prices up to the highest level known for several years. While this gain was not fully maintained, there was still a substantial improvement in the average price for the year. Nearly all the leading mines maintained their output, and many of the smaller ones increased it considerably. There was a decrease of about 12 per cent. in the exports of copper for the year, so that the increase in price was largely due to the heavy domestic demand.

The production by States was as follows:

UNITED STATES PRODUCTION OF FINE COPPER IN 1895.

States.	Pounds.	Metric tons.
Arizona	48 399,403	21,954
Michigan	129,740,765	58,850
Montana	194,768,925	88,346
Colorado	6,125,000	2,778
Utah	2,664,757	1,209
Eastern and Southern	3,255,000	1,476
All others	1,500,000	681
Total production	386,453,850	175,294

Gold.—There was a notable gain in the amount of gold obtained from our mines, which in 1895 reached a total of 70,470 kilogrammes (2,265,612 ounces) fine metal, value $46,830,200, showing a gain over 1894 of 7,671 kilogrammes (246,381 ounces). This result shows that the impetus given to gold mining all over the world by the events of the past two years has not reached its maximum. Since there has been no general resumption of hydraulic mining in California the increased production of gold has been due to an ex-

* Continued from SUPPLEMENT, No. 1060, page 16948.

tension of the working of old mines; to the opening of new mines, and to a continued improvement in methods of working and reduction of ore which now permit the profitable exploitation of mineral properties too low in grade of their ores to pay under former wasteful or imperfect systems. While the increase in the production of the yellow metal has been very generally distributed, the most notable gain has been made in Colorado, where it was due not only to the active working of the Cripple Creek mines, but to the steady gain reported from the older gold districts of the State. The other Western States have also shown considerable gains; Montana and Idaho both recording large advances, while California also showed a large increase, and the development of the gold fields of Utah proceeded quietly but on an important scale. In Arizona, owing to local circumstances, there was a decrease in the gold output. In the Southern States there has been little change.

Iron.—The production of iron in 1895, as compared with the previous year, presents the most remarkable change ever shown in two consecutive years in this country. Not only was there a sharp reaction from the depression of the previous year, but the output reached the highest level yet attained. There was made in the United States last year 9,597,449 metric tons (9,446,308 long tons) of pig iron, an increase of 42 per cent. over 1894, when the total was 6,764,572 metric tons (6,657,388 long tons). The highest production on record previously was 9,353,020 metric tons (9,202,702 long tons), in 1890. This advance once more puts the United States in the position of the leading iron producing nation of the world. A comparison of the four principal countries shows that while we made 9,600,603 metric tons of pig iron, Great Britain turned out 7,620,000 tons; Germany, 5,788,798 tons; and France, 2,005,889 tons. That is, to put it in another form, if we take our own output at 100, that of Great Britain was 79, Germany 60, and France 21.

An increasingly large proportion of this iron is each year converted into steel, and our steel production in 1895 was nearly 6,004,000 metric tons, of which approximately five-sixths were Bessemer and one-sixth open hearth steel. The total was 20 per cent. greater than the largest heretofore reported in any one year.

In making this pig iron there were used a total of 17,753,710 metric tons (17,474,123 long tons) of iron ore, of which 17,221,200 metric tons (16,950,000 long tons) were produced from our own mines and 532,510 metric tons (524,123 long tons) were imported. Thus about 3 per cent. of the pig iron was made from imported ores, though native coal and flux were used in its manufacture.

Lead.—The production of lead from domestic ores in 1895 showed a decrease from the previous year. It amounted to 142,298 metric tons (156,854 short tons), a decline of 2·5 per cent. This was due to the very large quantity of lead smelted from foreign ores or refined from foreign bullion, the total consumption showing a considerable increase. The details of production and consumption are shown in the following table:

UNITED STATES PRODUCTION OF LEAD IN 1895.

Production.		Tons of 2,000 lb.	Metric tons.
Desilverized		119,057	107,985
Non-argentiferous		32,797	29,747
Antimonial		5,000	4,535
Total, domestic		156,854	142,267
Refined from foreign ores		70,745	64,166
Total output of American works		227,509	206,432
Imports, refined		23,412	21,235
Balance of crude imported		6,314	5,727
Stock, January 1, 1895:			
At works	5,453		
In bond	7,181	12,634	11,459
Total supply		269,986	244,877
To Deduct:			
Exports	18,130		
Stock, December 31, 1895	9.110		
In bond, December 31, 1895	9,865	37,105	33,654
Consumption		232,881	211,223

Quicksilver.—There was a marked increase in production in 1895, the total being 1,219 metric tons (35,122 flasks), against 1,056 metric tons (30,440 flasks) in 1894. The metal was entirely from the California mines, no new sources of production having been developed during the year.

Silver.—The silver production again showed a decrease; in 1895 it amounted to 1,441,087 kilogrammes (46,331,235 ounces) of fine metal, of the commercial value of $30,244,296, a decrease of 109,300 kilogrammes (3,515,640 ounces) from 1894; while the total was about 76 per cent. of the production of 1893. The quantity of silver actually refined and put upon the market by the various smelters and refiners in the United States was considerably greater than this, but we have carefully deducted all the metal produced by them from foreign ores and bullion, and the quantity given is only that of the metal obtained from domestic ores. The reduction in output, combined with other circumstances, has had the effect of raising the price of silver slightly, the average price or commercial value for the year being 65·3 cents per ounce, or about 2·3 cents per ounce greater than in 1894. We may note here the fact that in spite of the continued low price and the general decrease in output, some of our larger mines have continued steadily at work with fairly profitable results. Such mines as the Ontario and the Daly in Utah have shown no disposition to abandon production, and the silver-lead mines of Idaho have diminished their output rather on account of other circumstances than because of the price of the white metal.

Zinc.—The total production of spelter or commercial zinc in 1895 was 74,245 metric tons (81,858 short tons). The year was marked by an extension of mining and of output to an extent greater than the consumption, resulting in continued low prices. With the present abundant supply these may be expected to continue until new uses are found for the metal and the demand is correspondingly enlarged; unless, indeed, the combination which now controls a large part of the production of spelter should attempt to advance prices above 4 cents per pound, when a further restriction in consumption might be expected.

PRODUCTION OF METALS FROM FOREIGN ORES.

The work done by our metallurgical plants is not fully expressed by the figures given in our table, which are limited to the production from domestic ores. We add below a supplementary table showing the quantities smelted, refined or otherwise extracted from foreign material in 1895:

METALS PRODUCED FROM FOREIGN ORES AND BULLION.

Metals.	Customary measure.	Quantities. Customary measure.	Metric tons.	Values.
Copper	Lb.	14,000,000	6,350	$1,330,000
Gold	Troy oz.	205,763	*6,400	4,253,121
Lead	Short tons.	70,745	64,166	4,570,127
Nickel	Lb.	3,880,000	1,760	970,000
Silver	Troy oz.	28,190,524	*876,838	18,380,222
Total				$29,503,543

* Kilogrammes.

These metals were chiefly from material received from Mexico and British North America. In the case of our northwestern neighbor the smelting ores from the mines are usually sent to our smelters at Tacoma, San Francisco and elsewhere. From Mexico we receive chiefly base bullion, from which a very considerable part of our lead supply is obtained, as noted in the paragraph on that metal. The nickel is all from ores or matte received from the Sudbury mines in Ontario.

We have not included above the iron smelted from foreign ores, which is small in actual amount, and very small in comparison with the total output.

The lead industry is the trade most affected by the use of foreign material, the quantity of copper being comparatively small. In the case of nickel no ores of that metal are now produced in the United States.

THE NON-METALLIC PRODUCTS.

The total amount of the non-metallic products is greater than that of the metals, because of the large quantities and values of a few items.

Abrasives.—Little remark is called for on these substances. The results shown are varying, corundum and emery showing some decrease, as do also tripoli and infusorial earth, while there was a large increase in grindstones and whetstones.

Alum.—The growth of this industry is steady and satisfactory, as is shown by the large production. Some alum is made from imported bauxite and other materials, including cryolite, which is not produced in this country.

Asbestos and Talc.—The output of asbestos showed a considerable increase in 1895, chiefly due to the working of mines in Georgia, which have been opened within the past two years. We still continue to import a large part of our supply. The output of fibrous talc was increased to meet a growing demand; it all comes from a limited area in New York, where the mines are actively worked under a combination. The production of talc and soapstone declined slightly.

Asphalt.—The asphalt and bituminous rock reported are chiefly from California. The gilsonite deposits of Utah are not actively worked, owing to difficulties of transportation. The use of asphalt in the United States is rapidly extending, but the chief reliance is on imported material, the island of Trinidad furnishing the larger part of the supply.

Barytes.—There was a slight decrease in this mineral, coupled with an increase in its value.

Bauxite.—A considerable increase is reported, due to the organization of new companies and the opening of new beds in Georgia and Alabama. No other deposits have been worked.

Borax.—No change in production or methods is to be reported. The output—wholly from California and Nevada—shows a slight increase.

Bromine.—Only slight changes are noted, with no difference in methods.

Cement.—Notwithstanding the extent of our natural resources in cement materials, an increased demand in 1895 was supplied from abroad and our own production shows little change.

Clays.—The production of clays increased with the demand for building materials. The increase was especially to be noted in the refractory clays used for the manufacture of fire brick and the like, and in the china clays, such as kaolin and feldspar.

Coal and Coke.—As might be expected in a year of industrial activity, the coal production showed a notable gain. In the Journal of January 4, we estimated the total output for 1895 at 176,904,000 metric tons (195,000,000 short tons). The fuller returns now received put the total at 178,212,591 metric tons (196,442,451 short tons), showing a change of 0·7 per cent. from our preliminary statement, and an increase of 17 per cent. over the output in 1894.

A few corrections are still to be made, but the present figures will not be materially changed in the final statement for the Mineral Industry, where the details of production will be found. The output was as follows:

	Metric tons.	Short tons.
Anthracite	52,946,900	58,362,986
Bituminous	125,265,691	138,079,466
Total	178,212,591	196,442,451

The total quantity of coke made increased largely, as might be expected; it was 9,006,090 metric tons (9,927,348 short tons) in 1895.

Our coal resources are so large and the competition of the different producing regions for the important markets is so sharp, that there was very little change in the average prices; less, indeed, than in any of the other staple articles in the list. The anthracite coal production was perhaps unduly large, owing to the peculiar conditions of that trade during the year. The output of bituminous coal and coke was stimulated by the activity in the iron market and in manufacturing industries generally. Some efforts were made during the year to increase our export trade in mineral fuel, but with comparatively little success, in spite of the abundance of our supplies and their excellent quality.

Cobalt Oxide.—The small production showed little change in its amount or sources.

Copperas.—But little change is reported, but there was a decrease in prices and values.

Copper Sulphate.—This is an important product, and our exports last year to Europe and Mexico reached a considerable figure.

Fluorspar.—The single producing mine in Illinois showed a decrease, this being one of the few products which declined in amount.

Graphite.—No new developments have been made and the home production is still chiefly controlled by a single interest.

Gypsum.—The use of this material varies little from year to year. Considerable developments have been made in the extensive fields existing in Iowa.

Lime.—This widely made material, like others used in construction, shows a fairly steady growth, but no special features are to be reported. A total of 5,443,164 metric tons (60,000,000 barrels) shows the importance of the industry, but the statistics of production are not satisfactory, owing to the burning of lime in so many places and by farmers who keep no record of their output.

Magnesite.—The production in 1895 showed a total of 1,995 metric tons (2,200 short tons). It is derived from the California deposits entirely, and the production increases slowly as the use of the material extends.

Manganese Ore.—Our production—15,121 metric tons (14,883 long tons) in 1895—is chiefly limited by the cheapness with which supplies can be imported. There was an increase of nearly 25 per cent. in 1895.

Mica.—The production of 343 metric tons (38,356 pounds) continues to come chiefly from New Hampshire and North Carolina. Some new deposits in Idaho are being developed.

Mineral Wool.—We have introduced this product for the first time, its manufacture from blast furnace slag representing the partial utilization of material formerly wasted. There were 6,115 metric tons (6,742 short tons) made in 1895.

Monazite.—The special demand for this mineral continues to increase, and the total reached 862 metric tons (1,900,000 pounds), or much more than double that of 1894.

Mineral Paints.—An increased demand is apparent in the figures of the table. The largest gain is in white lead, of which in 1895 there were 83,462 metric tons (92,000 short tons) of "dry" produced.

Phosphates and Marls.—The output of mineral fertilizers for domestic use showed some increase, but owing to the diminished exports the total production of phosphate rock fell off both in quality and in value. The cause of the smaller sales abroad is found to be in part the opening of the deposits of phosphates in Tunis and Algiers, and in part the use of other sources of phosphoric acid, such as the Thomas slag from the basic steel process.

Precious Stones.—No change was made in our small production.

Pyrites.—The total production, chiefly used in the manufacture of sulphuric acid, was 82,296 metric tons (81,000 long tons), showing a decrease from 1894, largely due to the cheapness of imported supplies.

Petroleum and Natural Gas.—The petroleum and natural gas industries show but little change. While our petroleum production is not diminishing, and while the consumption steadily increases here, the exports are slowly decreasing, owing to the increased competition of Russian oil in the Eastern markets, which were formerly supplied entirely from this country; and in Europe not only to the use of the Russian oil, but to the largely and rapidly gaining production of Galicia, which threatens in time to be sufficient to supply a large part of Eastern and Southern Europe.

Salt.—Of the minerals necessary to existence, salt shows an increase a little greater in proportion than the normal growth of our population, due to our growing chemical industries, and that demand may be expected to continue increasing, as those industries are developed on a scale approximating the growth which they have already attained in Europe.

Slate, Stone and Other Building Materials.—All these substances show increases, due to the greater amount of construction work and the revival of business. The value of these products in the aggregate is large, but it is extremely difficult to secure accurate statistics of some of them, owing to the widely scattered nature of the industries, and the fact that they are largely carried on in a small way and intermittently, as demand requires. The estimate given is as close as the circumstances permit.

We are indebted to Richard P. Rothwell, of the Engineering and Mining Journal, for the above interesting statistics.

THE FUTURE COTTON MILL.*

IT is with some hesitation that I venture to address the club upon this subject, for I recall with a shudder the two colossal bores that society abhors, namely: the one who is always telling us what is going to happen and the other who is always greeting us with "I told you so." The first we would gladly see shot, while nothing short of vivisection would complete our gratification at the fate of the other. I realize that the ground I am about to tread is full of pitfalls, and that no man can hope to traverse it without incurring the sharpest criticism, not to say ridicule. My aim, however, is to be suggestive rather than predictive.

At this moment, when the minds of manufacturers are directed to the sharply increasing competition at home and abroad, and to the constantly narrowing or disappearing margin of profits in business, it may be well, so far as we can, to make a study of what lies before us.

My friends, you will pardon me if I indulge in a little flight of the imagination and picture to your minds the future cotton mill of New England. In doing this I do not arrogate to myself any of the spirit of prophesy, nor do I go any farther than many of you have gone who have given thought to the subject, nor do I invade the realm of miracles, but keep well within the bounds of reasonable expectation. I only put into the form of words what others have from time to time contemplated as possibilities. While I suggest and forecast methods and inventions, I do not expect to be held responsible for the exact and precise devices which may be required to obtain the ends desired.

In view of the wonderful advance that has been made in the last twenty-five years in cotton manufacturing, the wildest imagination can hardly go astray in predicting the future. Invention is moving at an

* Paper read before the Arkwright Club at the recent meeting in Boston by the Hon. William C. Lovering, of Massachusetts.

accelerating pace. The inventor is ready and anxious to surmount apparent impossibilities, and what a few years ago were regarded such are continually yielding to his ingenuity.

There are not wanting doubtful Thomases who do not believe anything can ever be accomplished. Indeed, much the larger part of the world belongs to this class. Not being able to solve a difficulty themselves, they think it beyond the power of any one to do it. This class has its place, however, for, while it discourages many, it piques and stimulates the stronger and more persistent to increased activity of mind.

It has come to this, that the manufacturer of to-day hears of a new invention calculated to revolutionize all his plans, with a mingled spirit of resistance, impatience and foreboding of injury. He looks upon the inventor as his natural enemy. He resents his invention as an innovation that is aimed at his prosperity and finally adopts it only in self-defense. No one knows this better than the wily inventor or promoter himself. He sets to work in his peculiarly subtile and skillful manner to circumvent his victim, knowing that he has only to get his ear and convince his reason and he will have him completely at his mercy.

The up to date mill of ten years ago is lagging in the race to-day, or almost obsolete. The only reason it does not drop entirely out is that there is not enough of the latest modern machinery now running to supply the current wants of the trade.

The complete model cotton mill is a unity in itself, built upon a comprehensive and systematic plan, and so exactly balanced in all its parts that any substantial change as an afterthought disturbs the balance and imperils a perfect result.

The cotton mill of the future will make its demand upon every branch of science and physics, and every modern invention needed will be impressed into its service.

The future cotton mill will have at the plant no visible power. The power will be brought on wires or in pipes from its source, which is perhaps miles away. The waterfall, the wind, the tide or chemical action may be the initial forces to be distributed by the agency of an electrical current or air pressure.

There will be no long lines of shafting to be kept in order at a great cost of labor, power, and lubricants. Each and every machine will be run by a motor which will be a part of the machine itself. The cost of dynamos and motors is constantly becoming lower. The money saved by the disuse of shafting and belting will go far toward equipping the machines with motors. The power required to run heavy shafting and belting will go far toward supplying the waste in transmitting electrical force.

The time is coming when every cotton machinery builder will be expected to supply with each card, drawing frame, speeder, spinning frame and many other machines, a suitable motor exactly adapted to the power and speed required. Sections or groups of looms may be run by motors.

Cotton.—In no department of manufacturing is there greater opportunity for improvement than in the condition of the staple itself as it is shipped from the South. Cotton is one of the most delicate fibers in the world, and yet there is no article of commerce that is so brutally handled, from the moment it is picked until it arrives at the mill. The fault is with the manufacturers. They demand nothing better than they get, and they get nothing better than they demand.

Some day the manufacturers will wake up to a realizing sense of their wrongs, and demand that their raw material shall be delivered to them in better condition. Then some enterprising shipper will make haste to lay down in our mills clean cotton, well baled, and billed at net weights. Just now, however, it is easier to say "it cannot be done" than that "it must be done." As competition between the North and the South increases, we must insist that our cotton shall be delivered to us in a more advanced stage of preparation. The cotton need not cost any more by reason of this demand. The cheap negro labor of the South should be able to do all that is necessary.

The future cotton mill on white work will have no picking room. The first process in the New England mills will be carding. The cotton will be brought from the cylindrical press in the South in a thoroughly cleaned and evenly rolled lap of a standard weight, of a given number of ounces to the yard, and of a standard width, say forty inches, ready to be placed up to the card. The sliver coming from the card will be as even as that now coming from the first drawing. There is a chance for the inventor to devise an efficient evener somewhere between the feed roll and the coiler.

Coarse yarns may be spun directly from the card sliver or a card can be fitted with condensers and with spindles directly in front of the doffer. Coarse yarns may thus be spun directly from the card itself.

The waste from an up to date card should be very slight, but whatever there is should be worked by itself and not be put back into the regular work.

There is an old saying that picking, carding and spinning cannot be done in the loom. This is merely another way of saying that these preparatory operations should be so complete that when their products arrive at the loom there should be no breakage of either warp or filling by reason of imperfect yarn.

Spinning.—From the distaff to the Hargreaves jenny is not farther than from the jenny to the modern spinning frame, whether the quantity or quality of product be considered. It is reasonable to assert that the improvement is to continue and that the spinning frame of to-day will be outclassed a short time hence.

For most purposes of weaving the frame spun yarn is sufficient. It is just at this point, however, that some of the greatest improvements are demanded. Frame spinning is at once the most vexatious, uninteresting and wasteful process in the mill. It requires unceasing watchfulness and a peculiar dexterity to produce a full quantity of perfect yarn, and avoid making waste.

The work is monotonous and as it is not generally paid for as strictly piece work, it lacks the stimulus of increased earnings as the result of increased effort on the part of the operative.

In the cotton mill of the future, the operative may be expected to tend many thousand spindles. It is difficult to fix the limit. The largest number of spindles that I have been able to find attended by one spinner is 1,728 frame spindles running on No. 28 yarn. This of course means that the preparation is of a high order and the cotton of a good high even running grade. Already there is a change coming over the spinning frame, and it is not impossible that in another twelve months a single spinner will be running 3,000 spindles with less trouble than he is now running 1,000 spindles.

The amount of waste made at this point will be hardly 10 per cent. of what is now made. The frames will run continuously and may be left for an hour or more without any attention whatever, excepting to stop the frame when it is ready to doff, and even this service may be dispensed with sooner or later.

The frame spinning room will be a clean room. There will be no accumulation of fly. The sweeper with his windmill broom may be dismissed. Frames will be cased in and a downward draught will carry away all the fly and dust that are thrown off. Indeed it is strange that this has not been done long ago.

The Loom.—Weaving is the most interesting operation in the mill. It requires skill and affords lucrative employment to the operator.

As soon as the demand is made upon the inventor, he will make the loom comparatively noiseless, and so far as human ingenuity can make it, automatical in all its movements.

The Northrup loom has already proved itself to be one of the great mechanical triumphs of the nineteenth century. It is indeed but the fulfillment of a satirical prophesy published more than fifty years ago, which prefigured in the minutest detail all that this wonderful loom has since accomplished.

The time is not far distant when we may expect to see fifty looms run by a single weaver, and there is no reason for fixing the limit at fifty.

Taking the Northrup loom as a basis, let us look into a possible weave room of the future, running on plain two harness work, such as print cloth, or sheeting if you will. On a single floor there are a thousand looms run by fifty weavers whose only duty will be to mend broken warp threads and start the looms. The yarn is so even, perfect, and strong as to cause the minimum amount of breakage. The warp is flowing continuously into the loom from a room below, where the new warp will be twisted on to the old warp without stopping the loom. Warps may be several thousand yards in length.

The woven cloth will pass into the room below, where it will be examined and taken to the finishing room in as large rolls as can be conveniently handled. There will be no trucking of warp beams and cloth in the weaving room. The filling will be placed in a receiver above the magazine, and in such shape that it will be fed into the magazine automatically.

Labor.—The future cotton mill will eliminate skilled labor. While it will demand strong and able bodied workers who will be diligent and alert, it will not call for that close attention and exercise of the mental faculties that are necessary in supplying the deficiencies of crude and imperfect machinery. Brains and intelligence will be required of the machine builder and inventor, to so perfect mechanical operations that the work of the operative shall be merely the daily routine of a care taker.

General Management.—Any consideration of this subject would be incomplete if no reference were made to the most important element of all, namely, business management. We can easily see how the best mill in the world, fitted out with the latest improved machinery and with every approved appliance, might prove an absolute failure by reason of bad management, lack of judgment and uneconomical administration.

It does not follow that the advent of every new invention should be the signal for discarding the old machinery and adopting the new.

"Too early arrives as tardy as too late." There are times when it would be obviously unwise to supplant good machinery with crude and untried inventions which have not yet proved their worth.

From the inception of an invention to its complete establishment is often a long and tedious road. The principle or idea involved in a patent may be of value, but until it has been perfected and put on a practical basis, it cannot be claimed that it is indispensable.

It is just here that administrative and executive ability is wanted. It is well known in all the business of life that the man who commands and controls the best services, talents and energies of his fellow men is the most successful.

The man of experience with a cool head and calm judgment will be neither the first nor the last to forsake the old and adopt the new. To direct the right movement at exactly the right moment requires no end of judgment and foresight.

Such, gentlemen, is your office, and with these few hints upon the future cotton mill, I leave the subject with you. I might pursue it further and enter into detail upon points that I have barely touched. I have said enough already perhaps to excite derision.

I assure you, however, that I have restrained myself lest I might be called fantastic. I might have told you of cotton carded by the wind, which is not deemed entirely impracticable.

I might have told you of the loom that is run with endless weft. I might have told you of the electrical loom which has run one thousand picks a minute on print cloth and made practically no noise.

I might have told you of the spinning frame that will stop itself, doff itself and start itself without the aid of human hands, that will run day and night without making any waste.

I might have theorized upon the expectation that some day a short cut will be found to utilize the great power of the sun's heat. That the actinic ray or some other sun force will be reduced to service. That the heat of summer will be stored for use in winter. That the light of day will be stored to be used at night. But already I think I hear you whispering "Fairy Tales."

I have therefore tried to confine myself to what may be termed reasonable possibilities. I do not say that all of these things will come to pass exactly in the way I have stated them, but to deny that they will come in some way is to say that the world does not move, never has moved, and never will move.

This much can be said, that the last twenty years has witnessed the fulfillment in the manufactural world of predictions quite as startling and chimerical as any that have been stated. A few years hence, when all of these and many more wonders shall have come to pass, some one will arise, and standing on the vantage ground of their realization, point out new worlds to conquer, new miracles to be wrought, new difficulties to be overcome and new forces to be applied. In due time human ingenuity will have met every demand, and so the work of infinite development will go on.

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